AWO-160

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Doc # 13707

1601 Golden Aspen Drive • Suite 103 • Ames, Iowa 50010 • 800.433.3469 • www.foxeng.com

December 4, 2007

Ms. Nina Koger, Lead Engineer
Energy & Waste Management Bureau
Iowa Department of Natural Resources
502 East 9th Street
Des Moines, Iowa 50319

RE: 2007 Annual Groundwater Quality Report
City of Muscatine C&D Landfill
70-SDP-4-78C
P.N. 6008

Ms. Koger:

Find attached a copy of the 2007 Annual Groundwater Quality Report for the City of Muscatine C&D Landfill.

A copy of this data has been forwarded to Ms. Laura Liegois, Solid Waste Manager and Field Office #6 as required by the Permit.

Sincerely,
FOX ENGINEERING ASSOCIATES, INC.

Todd Whipple, CPG
Project Manager

22471 DEC05'07 AM10:23

2007 ANNUAL GROUNDWATER QUALITY REPORT

FOR THE

MUSCATINE C&D LANDFILL
PERMIT 70-SDP-4-78C
MUSCATINE, IOWA

by:
FOX Engineering, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, Iowa 50010
(515) 233-0000

6008-07B.320

ANNUAL GROUNDWATER QUALITY REPORT

November 19, 2007

Ms. Nina Koger, Lead Engineer
IDNR – Energy & Waste Management Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, Iowa 50319

RE: Muscatine C&D Landfill
CLOSURE PERMIT # 70-SDP-4-78C
FOX PN 6008-07B.320

Dear Ms. Koger:

This Annual Groundwater Quality Report has been prepared in accordance with IAC 567-113.26(8) and the Closure Permit (Appendix A).

1. ANNUAL REPORT SUPPLEMENT

This report supplement addresses the numbered information requests set out in the December 1, 2004 IDNR Letter and reiterated in the February 14, 2006 IDNR Letter (Appendix A).

1) The geology and hydrogeology are described in the Hydrogeologic Investigation Report (HIR) and Hydrologic Monitoring System Plan (HMSP) prepared by Green Environmental Services, Inc., February, 1994 (Appendix B).

   Previous land use is believed to be an undeveloped ravine.

   The former solid waste stream consisted of a single demoltion/construction debris event within the City of Muscatine. This event occurred in the late 1970's.

2) The approved monitoring network is illustrated in Sheet 1.

3) The Water Table Contour Map is included as Sheet 1.

4) A Potentiometric Map of the Regional Aquifer is not included. The potentiometric surface slopes south toward the Mississippi River.

5) It appears that shallow groundwater mimics the topography and slopes to the southeast. The upgradient water table well (MW-6) does not appear to be impacted by the construction demolition fill. The remainder of the monitoring network appears to be situated to effectively detect any migration to downgradient wells.

6) Current water quality data is included in Appendix C. Current and historic water quality is included in Appendix D.

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7) The upgradient well (MW-6) appears to be functioning effectively as valid upgradient sampling point based on both the hydrogeology and the water quality results. The approved Hydrologic Monitoring System Plan (HMSP) does not include surface water monitoring points.

8) Control limits are calculated in the spreadsheets included in Appendix D. Comparison of the downgradient water quality data to the calculated limits is presented in the text below.

9) Graphical representations of water quality data, calculated control limits, and EPA Maximum Contaminant Limits (MCL's) are included in Appendix D. Comparison of the downgradient water quality data to the calculated limits is presented in the text below.

10) Discussion of the groundwater quality data is presented in the text below.

11) A discussion of the surface water quality data is not applicable.

12) Conclusions and recommendations are included in a separate section at the end of this report.

ANNUAL REPORT

1. **Effects on Surface Water:** Surface water at the site is controlled by vegetation and City street infrastructure. There are no surface water points being sampled at the present time.

2. **Effects on Groundwater:** A summary of analytical data for each monitoring well in the HMSP and the Analytical Reports for the past year are included as Attachment C. A summary of the statistical computations for the upgradient Water Table Well (MW-6) is included in the Concentration versus Time spreadsheets in Attachment D. The concentrations of the various compounds detected in each well are graphed over time versus the statistical limits calculated in the upgradient well. The graphs are included in the spreadsheets in Attachment D.

   The monitoring system includes monitoring wells intersecting the water table surface within glacial tills. The effects to the groundwater are discussed below.

   Monitoring wells comprising the Hydrologic Monitoring System Plan (HMSP) include MW 6 (upgradient) and MW 2, 3, 4, and 7 (downgradient). Analytical results from upgradient monitoring well MW-6 indicate historically detected concentrations of chloride, COD, iron, nitrogen ammonia, phenol, and TOX. The presence of the compounds in the upgradient well suggest that the compounds are endemic to the region, or, conversely, that an upgradient source of the compounds exists. It is noted that a cemetery exists upgradient of the site.

Detected concentrations in all monitoring wells are below the Primary Drinking Water MCL. The upgradient well (MW-6) and each of the downgradient wells MW-2, MW-3, MW-4, and MW-7 exhibit iron concentrations in excess of the Secondary Drinking Water MCL. Similarly, the chloride concentration at MW-3 exceeded the Secondary Drinking Water MCL in January, 1996; April, 1998; and October, 1998.

Those compounds that exceed the calculated statistical limit, but not the MCL are summarized by well as follows:

MW-2 - COD (10/99), TOX (10/96), phenol (10/98 & 10/00).
MW-3 - iron, chloride, nitrogen ammonia (7/95), COD (10/96), TOX (10/96), phenol (10/98).
MW-4 - chloride (prior to 4/01), COD (4/99), TOX (10/96 & 10/98), phenols(10/98).
MW-7 - iron (10/98), TOX (10/96), phenol (10/98).

Due to the presence of detectable concentrations of each of the listed compounds in the upgradient well, the elevated levels in the downgradient wells listed above are not interpreted as an indication of a leachate release into groundwater.

The detection of a compound above statistical limits during a single episode or during isolated episodes are not interpreted to represent a persistent leachate release. The interpretation is made that detection above the statistical limits during a single event, or during isolated episodes represents anomalous conditions in the well, the site conditions, or in the sampling activities.

Each parameter will continue to be routinely sampled and evaluated in accordance with the Special Provisions of the Permit.

3. **Monitoring Well Maintenance and Performance Evaluation:** Monitoring Well Performance Evaluation Reports dated April, 1999 and August, 2004 were prepared and submitted in accordance with IAC 567-113.21. The report concluded that the integrity of all MW's was intact, and that no changes in the HMSP were recommended. Monitoring well reevaluation is tentatively scheduled for the summer of 2009, and should again include all monitoring wells included in HMSP.

Review of the water elevation data for 2007 does not indicate excessive variability compared to historic water elevation data. Water elevation data is summarized in Attachment E. Based on the available water elevation data, the assessment of well conditions, and the hydrologic conditions at the site, the semi-annual water level measurements are interpreted to be sufficient to gauge notable changes in the site hydrology.

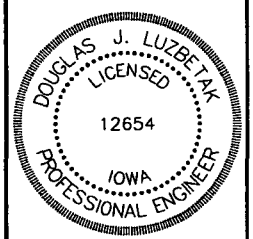
Flow paths are illustrated on the Groundwater Contour Map included as Figure 1.

4. **Leachate Control Plan:** This landfill is currently exempt from providing and implementing a leachate control system plan as per the Closure Permit. The conditional exemption is common in many Closure Permits at sites that were closed prior to the requirement for leachate collection systems. Our recent semi-annual Engineering's inspections have not revealed leachate seeps at the site.

5. **Explosive Gas Monitoring:** Explosive gas monitoring ceased at the site in 1998 based on authorization by IDNR in Provision 2, Permit Amendment #1, dated September 15, 1998 (Attachment A).

6. **Recommendations:**

   a. Continue routine monitoring of the HMSP monitoring wells and re-evaluate in the Annual Groundwater Quality Report due November 30, 2008.
   b. Continue water elevation measurements on a semi-annual basis.
   c. Continue Engineer's inspections on a semi-annual basis.
   d. Continue to monitor the integrity of the landfill cap.



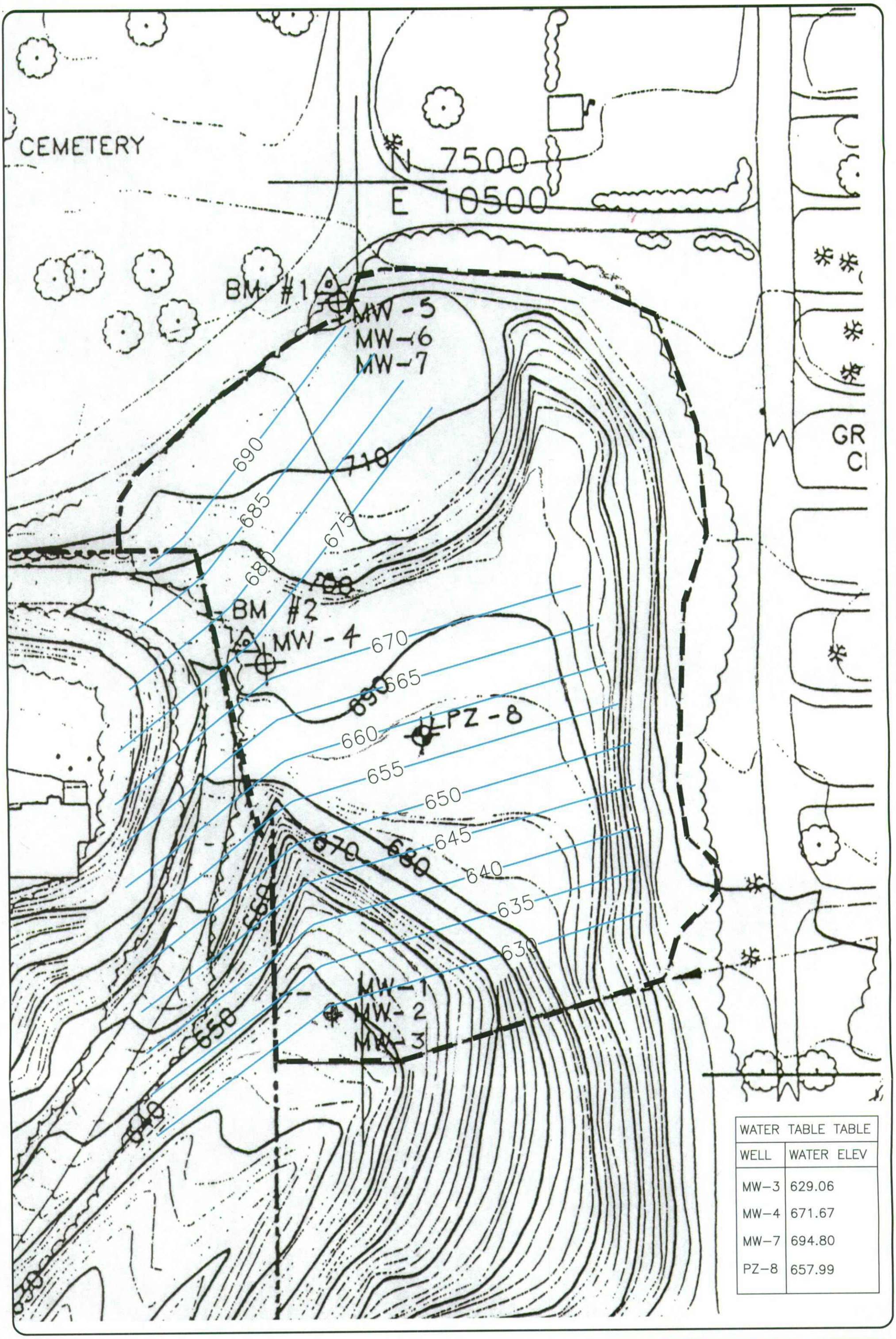
I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

11/19/07

DOUGLAS J. LUZBETAK, P.E. DATE
License number 12654

My license renewal date is December 31, 2008.

Pages or sheets covered by this seal: All



WATER TABLE TABLE	
WELL	WATER ELEV
MW–3	629.06
MW–4	671.67
MW–7	694.80
PZ–8	657.99

FOX engineering
FOX Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, Iowa 50010
Phone: (515) 233-0000
FAX: (515) 233-0103

SITE PLAN

GROUNDWATER CONTOUR MAP OCTOBER 2007

MUSCATINE C & D LANDFILL
MUSCATINE, IOWA

FIGURE: 1

REVISION	NO.	DATE
DRAWN JAK	PROJECT NO. 6008–03B	DATE 11–26–07

ATTACHMENT A

Permit & Amendments

RECEIVED FEB 1 8 2007

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

February 14, 2007

Lavene Payne, Solid Waste Manager
City of Muscatine
1000 S Houser
Muscatine, IA 52761

TDW —

RE: City of Muscatine C & D Landfill (CLOSED)
2006 Annual Water Quality Report
Permit No. 70-SDP-04-78C

Dear Mr. Payne:

We have reviewed the 2006 Annual Water Quality Report (AWQR), dated November 28, 2006, as submitted on your behalf by FOX Engineering Associates, Inc.

Based on our review of the report, the Department authorizes continued implementation of the recommended monitoring program, as follows:

1. Continued semiannual water quality analysis shall be conducted at all approved monitoring points as defined in the Special Provisions of the permit and/or any subsequent amendments.

All future AWQRs should include the 12 items described in the Department's December 1, 2004 correspondence.

If you have any questions, please contact me at (515) 281-8045.

Sincerely,

Michael B. "Mick Leat"
Environmental Engineer
Energy and Waste Management Bureau

ML\2006WaterQualityltrMuscatineC&D.doc

copy: Doug Luzbetak, P.E.
FOX Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

DNR Field Office #6
Nina Koger, DNR
Mick Leat, DNR

RECEIVED FEB 17 2006

Fields of Opportunities

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

February 14, 2006

Lavene Payne, Solid Waste Manager
City of Muscatine
1000 S Houser
Muscatine, IA 52761

RE: City of Muscatine C & D Landfill (CLOSED)
2005 Annual Water Quality Report
Permit No. 70-SDP-04-78C

Dear Mr. Payne:

We have reviewed the 2005 Annual Water Quality Report (AWQR), dated November 25, 2005, as submitted on your behalf by FOX Engineering Associates, Inc.

Based on our review of the report, the Department authorizes continued implementation of the recommended monitoring program, as follows:

1. Continued semiannual water quality analysis shall be conducted at all approved monitoring points as defined in the Special Provisions of the permit and/or any subsequent amendments.

All future AWQRs should include the 12 items described in the Department's December 1, 2004 correspondence.

If you have any questions, please contact me at (515) 281-8045.

Sincerely,

Michael B. "Mick Leat"
Environmental Engineer
Energy and Waste Management Bureau

ML\2005WaterQualityltrMuscatineC&D.doc

copy: Leslie Wolfe, P.E.
FOX Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

DNR Field Office #6
Nina Koger, DNR
Mick Leat, DNR

Fields of Opportunities

RECEIVED DEC 0 6 2004

LSW TAW

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
ALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

DJL ✓
Binder

December 1, 2004

Lavene Payne, Solid Waste Manager
City of Muscatine
1000 S Houser
Muscatine, IA 52761

RE: City of Muscatine C & D Landfill (CLOSED)
2004 Annual Water Quality Report
Permit No. 70-SDP-04-78C

Dear Mr. Payne:

We have reviewed the 2004 Annual Water Quality Report (AWQR), dated November 23, 2004, as submitted on your behalf by FOX Engineering Associates, Inc.

Based on our review of the report, the Department authorizes continued implementation of the recommended monitoring program, as follows:

1. Continued semiannual water quality analysis shall be conducted at all approved monitoring points as defined in the Special Provisions of the permit and/or any subsequent amendments.

In addition, all future AWQRs should include the following, starting with November 30, 2005 report:

1. A brief history of the site that describes the geology, hydrogeology, previous land-use, and solid waste streams.

2. An 11"x17" scaled site map delineating the approved monitoring network. All groundwater and surface water monitoring points shall be conspicuously marked and show its function as an upgradient, background, or downgradient sampling location.

3. A groundwater table contour map to evaluate groundwater pathways and to evaluate potential groundwater mounding. Data from leachate piezometers or wells should be included on the groundwater table contour map.

4. A potentiometric map should be included if a confined unit is being monitored.

5. A discussion of potential groundwater mounding and its influence on upgradient and downgradient wells.

6. A table showing all current and historic water quality data.

7. An evaluation of all upgradient groundwater and surface water points to determine whether they are currently functioning as a valid background/upgradient sampling points based on the groundwater table contour map and water quality data results.

8. Control limit calculations for each upgradient or background groundwater sampling point and whether the corresponding downgradient monitoring point falls within the calculated limits.

9. Graphical representation of water quality data in readable form. The current control limits and, if applicable, the Maximum Contaminant Levels (MCLs) should be clearly shown on each graph.

10. A discussion of the water quality data results stating whether potential leachate migration is occurring beyond the waste boundary at any groundwater monitoring point. If MCLs are exceeded, provide information on potential receptors.

11. A discussion, as applicable, of the potential impact of the landfill on surface water quality.

12. Conclusions and recommendations for future monitoring.

If you have any questions, you may contact me at (515) 281-8968.

Sincerely,

Jeff Simmons
Environmental Engineer
Energy and Waste Management Bureau

JNS\JNS\J:2004WaterQualityltrMuscatineC&D.doc

copy: Leslie Wolfe, P.E.
FOX Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

DNR Field Office #6

Nina Koger, DNR

Jeff Simmons, DNR

RECEIVED JUL 07 2003
TDW

Iowa
Fields of Opportunities

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

LSW ✓
DJL ✓
Binder ✓

July 2, 2003

Lavene Payne, Solid Waste Manager
City of Muscatine
1000 S Houser
Muscatine, IA 52761

RE: City of Muscatine C & D Landfill (CLOSED)
Permit No. 70-SDP-04-78C
Amendment #3

Dear Mr. Payne:

Enclosed is Amendment #3 to the permit issued on December 29, 1994, for the City of Muscatine C & D Landfill (CLOSED). The amendment and approved plans must be kept with the permit and the approved plans at the sanitary disposal project in accordance with solid waste rule 567 IAC 114.26(2)"c". Please review this amendment with your operators, as they must become familiar with it.

In accordance with the February 20, 2003 request from FOX Engineering Associates, Inc., the enclosed amendment authorizes the permit holder to move the schedule of monitoring events one month earlier by **1)** Allowing the semiannual sampling to be conducted in March and September of each year; **2)** Allowing the annual sampling to be conducted in September of each year; **and 3)** Allowing the water level measurements to be conducted in March and September of each year.

Note that the amendment may contain conditions that require a response or action by you, which if not properly complied with, may prompt enforcement action by this department.

If you have any questions, you may contact me at 515/281-8968.

Sincerely,

Jeff Simmons

Jeff Simmons
Environmental Engineer
Energy & Waste Management Bureau

JNS\JNS\J:MuscatineC&D94amd3X.doc

Attachments

cc: Todd Whipple, C.P.G.
FOX Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

DNR Field Office #6

Nina Koger, DNR

Jeff Simmons, DNR

IOWA DEPARTMENT OF NATURAL RESOURCES
AMENDMENT #3

Issued by: Nina M. Koger
Nina M. Koger
Environmental Services Division

For: the Director

Date Issued: July 2, 2003

Permit number 70-SDP-04-78C, issued on December 29, 1994, for the City of Muscatine C&D Landfill (CLOSED) is hereby amended by the following:

In accordance with the variance approval of September 15, 1998, the permit holder is authorized to reduce the frequency of groundwater level measurements from monthly, as required by current subrule 567 IAC 114.26(4)"b", to semiannually.

Accordingly, in accordance with the February 20, 2003 request from FOX Engineering Associates, Inc., the permit holder is authorized to conduct water quality sampling and water level measurements in March and September rather than April and October.

Replace Special Provision #5b and #5g with the following:

#5b. Quarterly sampling of the approved monitoring points has been completed. Continued semiannual sampling shall take place in March and September of each year for the parameters listed in 567 IAC 114.26(4)"e". Routine annual testing for the parameters listed in 567 IAC 114.26(4)"f" shall be conducted during September of each year.

The elevation of water in each monitoring well shall be measured and recorded on a semiannual basis in March and September.

#5g. An Annual Water Quality Report (AWQR) summarizing the effects the facility is having on groundwater and surface water quality shall be submitted to the Department's Main and local Field offices by November 30 each year. This report shall be prepared in accordance with 567 IAC 114.26(8)"d" by a Professional Engineer licensed in the State of Iowa. The AWQR shall include the results of the semiannual groundwater measurements and the routine semiannual and annual groundwater quality analyses conducted at the approved monitoring points. By means of a variance granted on September 15, 1998, groundwater measurements may be taken on a semiannual basis.

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Fields of Opportunities

STATE OF IOWA

THOMAS J. VILSACK, GOVERNOR
SALLY J. PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R. VONK, DIRECTOR

January 18, 2002

Robert McDonald, P.E.
Assistant City Engineer
Department of Public Works
1459 Washington Street
Muscatine, IA 52761-5042

SUBJECT: City of Muscatine C&D Landfill
#70-SDP-4-78C

Dear Mr. McDonald:

This letter constitutes Amendment #2 to the permit issued December 29, 1994 for the City of Muscatine C&D Landfill. The amendment and approved plans must be kept with the permit and the approved plans at the sanitary disposal project in accordance with solid waste rule 103.2(2)'c', IAC. Please review this amendment with your operators, as they must become familiar with it.

The amendment adds the following as a Special Provision to your permit:

The Emergency Response and Remedial Action Plan (ERRAP) prepared by Fox Engineering Associates, Inc. that was received on December 28, 2001 is in compliance with 567 IAC 102.16 and is hereby approved. An updated ERRAP shall be submitted at the time of any significant changes in facility closure operations that require modification of the currently approved ERRAP.

If you have any questions regarding this amendment, please contact Nina M. Koger at (515) 281-8986.

Sincerely,

for Lavoy Haage
Supervisor
Solid Waste Section

WALLACE STATE OFFICE BUILDING / 502 EAST 9th STREET / DES MOINES, IOWA 50319
515-281-5918 TDD 515-242-5967 FAX 515-281-6794 www.state.ia.us/dnr

LH:nmf

ATTACHMENT

cc: Field Office 6

N. Koger, IDNR

F. Hallada, IDNR

A.J. Johnson, City Administrator
City Hall
Muscatine, IA 52761

Lavene Payne, Solid Waste Manager
Public Works Bldg.
1459 Washington Street
Muscatine, IA 52761

Fox Engineering
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

STATE OF IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

September 15, 1998

Robert McDonald, P.E.
Assistant City Engineer
Department of Public Works
1459 Washington Street
Muscatine, IA 52761-5042

SUBJECT: Muscatine County Sanitary Landfill
#70-SDP-4-78C C+D landfill

Dear Mr. McDonald:

Enclosed is Amendment #1 to the permit issued December 29, 1994 for the Muscatine County Sanitary Landfill. The amendment must be kept with the permit and the approved plans at the sanitary disposal project in accordance with solid waste rule 103.2(2)'c', IAC. Please review this amendment with your operators, as they must become familiar with it.

The enclosed amendment (1) authorizes a reduction in the frequency of water level measurements from a monthly basis to a semiannual basis; (2) authorizes the permit holder to cease methane gas monitoring and annual reporting; and (3) authorizes a reduction in the frequency of routine site inspections from a monthly basis to a semiannual basis.

Please note that the permit contains special provisions that may require a response or action by you which, if not properly complied with, may prompt enforcement action.

If you have any questions regarding this amendment, please contact Nina M. Koger at (515) 281-8986.

Sincerely,

Lavoy Haage

Lavoy Haage
Supervisor
Solid Waste Section

LH:nmf

ATTACHMENT

cc: Field Office 6

N. Koger, IDNR

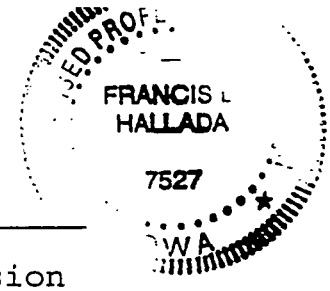
F. Hallada, IDNR

A.J. Johnson, City Administrator
City Hall
Muscatine, IA 52761

Lavene Payne, Solid Waste Manager
Public Works Bldg.
1459 Washington Street
Muscatine, IA 52761

Fox Engineering
1531 Airport Road
Ames, IA 50010

IOWA DEPARTMENT OF NATURAL RESOURCES
AMENDMENT #1



Issued by: _____
F. Hallada, P.E.
Environmental Protection Division

For: the Director

Date Issued: September 15, 1998

Permit number 70-SDP-4-78C for the Muscatine C&D Sanitary Landfill is hereby amended by the following:

1. In accordance with the variance approval of September 15, 1998, the permit holder is authorized to reduce the frequency of groundwater level measurements from monthly, as required by subrule 103.2(4)b IAC, to semiannually. The measurements shall be taken in April and October of each year, with the results submitted in the corresponding semiannual monitoring reports.

2. In accordance with the variance approval of September 15, 1998, the permit holder is authorized to cease methane gas monitoring and annual reporting, as required by IAC Subrule 103.2(15). However, in the event that methane gas is found to be present at the site, gas monitoring shall be immediately implemented.

3. The permit holder is authorized to reduce the frequency of routine site inspections from monthly, as required by Special Provision #6 of the permit, to semiannually. The inspections shall be conducted in April and October of each year, with the results submitted in the corresponding semiannual engineering inspection reports.

STATE OF IOWA

70-SDP-4-78C
PWA File

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

December 29, 1994

Lavene Payne, Solid Waste Manager
Department of Public Works
1459 Washington Street
Muscatine, IA 52761-5042

Re: City of Muscatine C&D Landfill
#70-SDP-4-78C

Dear Mr. Payne:

Enclosed is the closure permit for the City of Muscatine Construction and Demolition Sanitary Landfill. The permit and the approved plans must be kept on file for post closure use and reference. Please review the closure permit and plans with your staff, as they must become familiar with them.

Please note that the permit contains special provisions that may require a response or action by you which, if not properly complied with, may prompt enforcement action.

The permit is authorized continued use of the area as a construction rubble fill site.

If you have any questions regarding this permit, please contact Nina M. Koger at (515) 281-8986.

Sincerely,

Lavoy Haage

Lavoy Haage
Supervisor
Solid Waste Section

LH:nmf

ATTACHMENT

cc: Field Office 6

N. Koger, IDNR

F. Hallada, IDNR

A.J. Johnson, City Administrator
City Hall
Muscatine, IA 52761

Mr. Robert McDonald, P.E.
Public Works Bldg.
1459 Washington Street
Muscatine, IA 52761

Jim Mikolaitis, P.E.
GES, Inc.
P.O. Box 9007
Cedar Rapids, IA 52409-9007

IOWA DEPARTMENT OF NATURAL RESOURCES
SANITARY DISPOSAL PROJECT PERMIT

I. **Permit Number:** 70-SDP-4-78C

II. **Permitted Agency:** City of Muscatine

III. **Project Location:** Part of the NE 1/4, Sec. 3, T76N, R2W, 3 Acres, Muscatine County, Iowa

IV. **Responsible Official**

Name: Lavene Payne, Solid Waste Manager
Address: Department of Public Works
1459 Washington Street
Muscatine, IA 52761-5042
Phone: 319/263-8933

V. **Registered Design Engineer**

Name: Jim Mikolaitis, P.E.
Address: Howard R. Green Company
P.O. Box 9007
Cedar Rapids, IA 52409-9007
Phone: 319/395-0578

Registration Number: 11949

VI. **Date Permit Issued:** December 29, 1994

VII. **Permit Expiration Date:** December 29, 2024

VIII. **Issued by:** _____
Environmental Protection Division
for the Director

IX. **General Provisions**

The above named permitted agency is hereby authorized to close the sanitary landfill at the described location in conformance with Chapter 455B of the Code, the rules pursuant thereto existing the time of issuance, and any subsequent new rules which may be duly adopted, and any provisions contained in Section X of this permit.

The facility shall be closed according to the engineering plans and specifications approved by the Department of Natural Resources and these shall become a part of this permit. Any modifications or deviations from the engineering plans and specifications must have prior approval by the Department and an amendment to this permit issued.

The issuance of this permit in no way relieves the applicant of the responsibility for complying with all other local, state, and federal statutes, ordinances, and rules or other requirements applicable to the closure and maintenance of this closed sanitary landfill.

No legal or financial responsibility arising from the closure and post closure of the approved project shall attach to the state of Iowa or the Department of Natural Resources due to the issuance of this permit.

If title to this project is transferred, the new owner must apply to the Department for a transfer of this permit within thirty days of the date of title transfer. This transfer is void sixty days after the date of title conveyance unless the Department has transferred the permit.

This facility shall be surveyed as necessary and inspected as described in the special provisions of this permit. Semiannual reports shall be prepared containing a brief report describing the site's conformance and nonconformance with the permit and the approved plans and specifications during the inspections. These reports shall be submitted by May 1 and November 1 each year to both the Field and Main offices of the Department. The Department shall be notified if any inspection reveals any nonconformance with the permit and approved plans and specifications.

Failure to comply with Chapter 455B of the Code, or any rule of order promulgated pursuant thereto, or any or all provisions of this permit may result in a civil penalty of up to $5000 for each day of violation, pursuant to Section 455B.307 of the Code.

X. Special Provisions

1. The thirty-year post closure period for this facility begins on the date of issuance of this Closure Permit.

2. This site shall be closed and maintained in accordance with the approved Construction and Demolition Debris/Construction Rubble Landfill Closure and Post Closure Plan (C/PCP), dated May 2, 1994, and Plans dated March 19, 1994, as submitted by Green Environmental Services, Inc. (GES).

3. Issuance of this closure permit prohibits any additional regulated waste disposal, recycling, composting, and other related landfill activities which are subject to permit approval. However, the permit holder is

authorized continued use of the closed landfill for construction rubble fill, in accordance with the approved documents and permit conditions.

4. The permit holder shall submit a closure compliance report certified by a professional engineer registered in the State of Iowa upon completion of the final cap placement. The report shall certify that the site closure has been implemented in compliance with the rules, the Closure and Post Closure Plan, and the permit. The following information must be included in the report:

   a. As built plans showing changes from approved design plans, including the grading and seeding of borrow areas.

   b. A copy of the notation filed with the county recorder showing, for the purposes of title abstract, the existence of a landfill on the property, the types of wastes disposed of and dates of landfill use.

5. This site shall be monitored for water quality in accordance with the approved Hydrogeologic Investigation Report and Hydrologic Monitoring System Plan (HMSP), dated February 28, 1994, as submitted by GES.

   a. The HMSP shall include groundwater monitoring points MW-2, MW-3, MW-4, MW-6, and MW-7

      In addition, monitoring points MW-1, MW-5, and PZ-8 shall be retained as water level measuring points.

   b. First year quarterly sampling shall begin in April 1995. Subsequent quarterly sampling shall continue in July and October 1995, and January 1996 for analysis of the parameters listed in subrule 103.2(4)d and e IAC. Continued semiannual sampling shall take place in April and October of each year for the parameters listed in subrule 103.2(4)e IAC, beginning in April 1996. Routine annual testing for the parameters listed in subrule 103.2(4)f shall be conducted during October of each year, beginning in October 1995.

   c. Samples collected for dissolved metals analysis shall be **field filtered, preserved**, and promptly transferred to a certified laboratory.

   d. The Method Detection Limit (MDL) for the test parameters shall not exceed action levels as defined under IAC Chapter 133. If the action levels cannot be feasibly achieved using procedures described in

IAC Subrule 103.2(5), then the MDL shall not exceed the lowest feasible level.

e. If laboratory test results exceed the upgradient mean plus two standard deviations or the Maximum Contaminant Level (MCL) for any parameter, the Department shall be notified within 30 days of receipt of the analytical results.

f. Results of all analysis and the associated sampling forms shall be submitted to both the field and main offices of this department within 45 days of the sample collection.

g. An annual report summarizing the effects the facility is having on groundwater and surface water quality shall be submitted to the Department by November 30 of each year. This report shall be prepared in accordance with IAC Subrule 103.2(8)d by a professional engineer registered in the state of Iowa. This report shall include the results of groundwater level measurements conducted in the monitoring wells.

6. This site shall be inspected monthly for the first year, or more frequently depending on weather conditions. The frequency of routine inspections may be decreased, after the first year, but no less frequent than semiannually, if the permit holder provides justification that monthly inspections are no longer necessary to ensure proper maintenance of the site. Summarize all inspection data in the semiannual report defined in the General Provisions.

7. All diversion and drainage systems must be maintained to the approved specifications to prevent run-on and runoff erosion, or other damage to the final cover. These diversion and drainage structures must be designed to meet a 25-year, 24 hour rainfall event.

8. The vegetative cover shall be reseeded as necessary to maintain good vegetative growth. Any invading vegetation whose root system could damage the compacted soil layer shall be removed or destroyed immediately.

9. The integrity and effectiveness of the final cover must be maintained by making repairs as necessary to correct the effects of settling, subsidence, erosion, or other events. If damage to the final cover compacted soil layer occurs, repairs shall be made to correct the damage and return it to original specifications.

10. The permit holder shall quarterly monitor and annually report site methane concentrations in accordance with subrule 103.2(15) IAC after May 18, 1994. Specific

actions, as defined in the rules, shall be taken in the event of methane gas level limit exceedances The annual report summarizing the methane gas monitoring results and any action taken resulting from gas levels exceeding the specified limits during the previous 12 months shall be submitted by November 30 of each year.

11. The permit holder is conditionally exempt from providing and implementing a leachate control system plan. Continued exemption is subject to compliance with water quality standards, statistical limits per IAC subrule 103.2(6) through 103.2(8), and the control of leachate at the site. In the event that these conditions are violated, the permit holder shall be required to submit a groundwater quality assessment plan in accordance with IAC subrule 103.2(9).

12. The permit holder is exempt from Financial Assurance requirements, as provided in IAC Chapter 111, since municipal solid waste has not been disposed of at this facility.

ATTACHMENT B

Hydrogeologic Investigation Report & Hydrologic Monitoring System Plan

558988

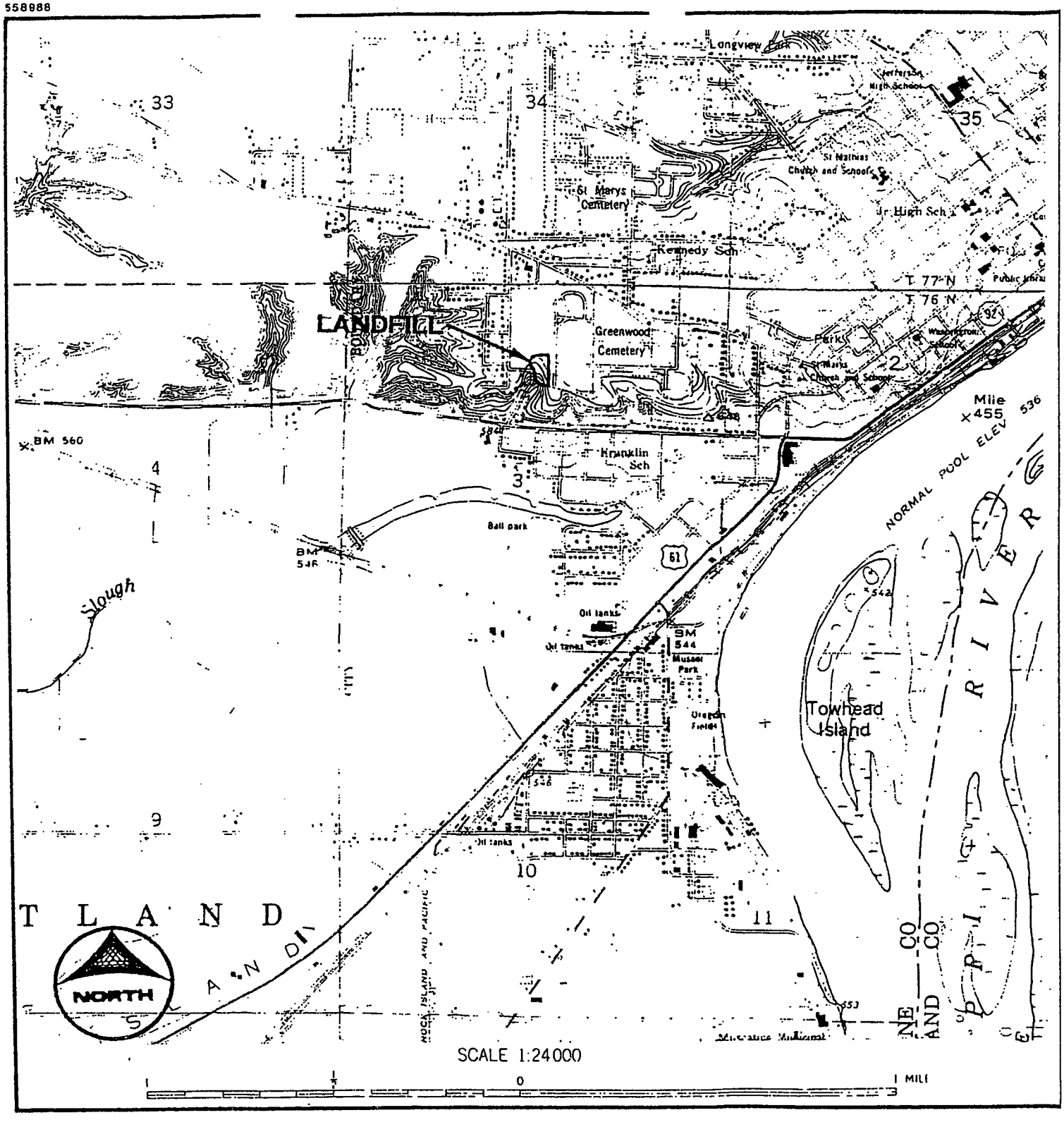


FIGURE 1

SITE LOCATION MAP

CONSTRUCTION RUBBLE LANDFILL

MUSCATINE, IOWA
FEBRUARY, 1994

Green Environmental Services, Inc.

CJZ714520J/0610

Cross-Sections

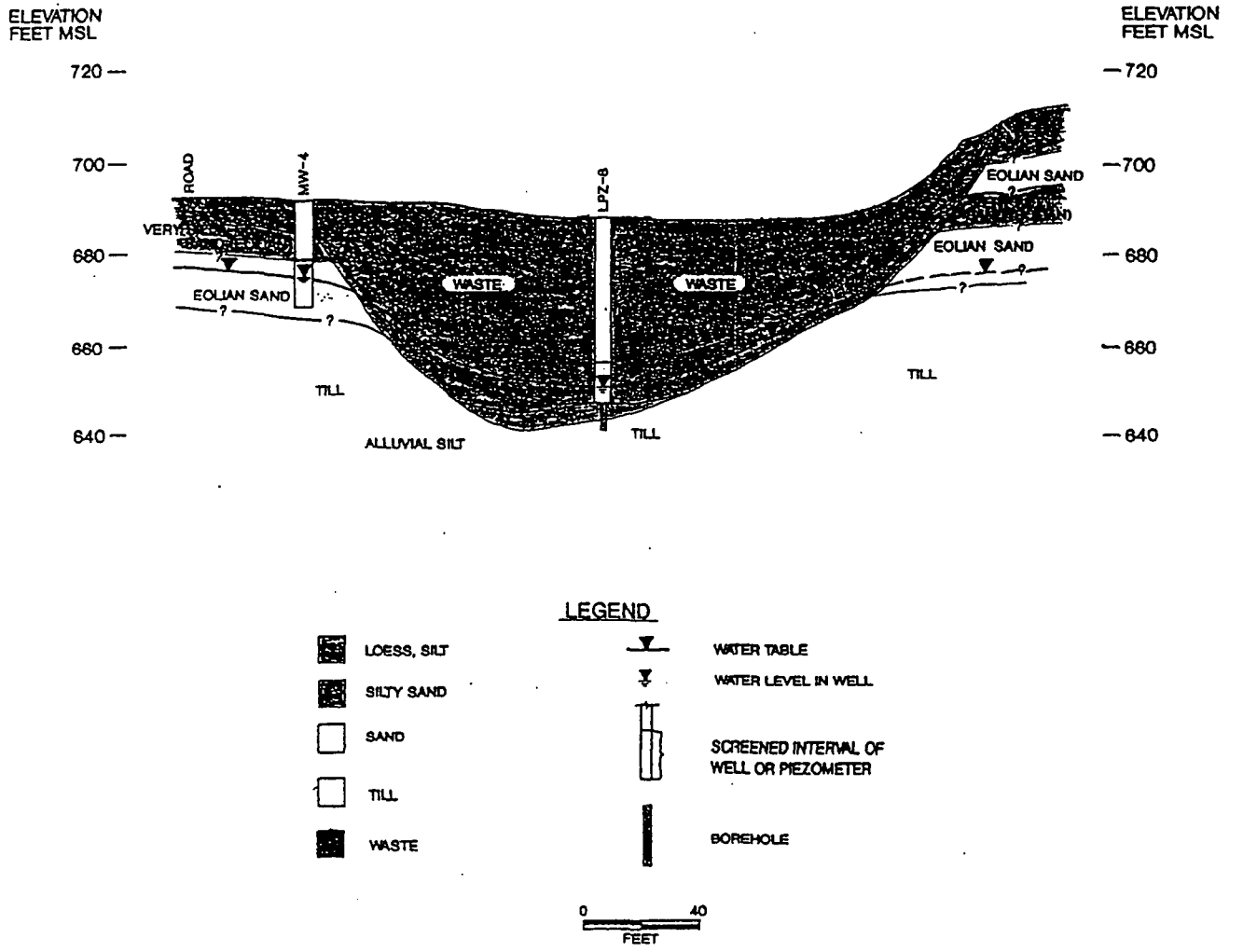


FIGURE 4

GEOLOGIC CROSS SECTION

CONSTRUCTION RUBBLE LANDFILL

MUSCATINE, IOWA

FEBRUARY, 1994

Green Environmental Services, Inc.

CJZ714520J/0610

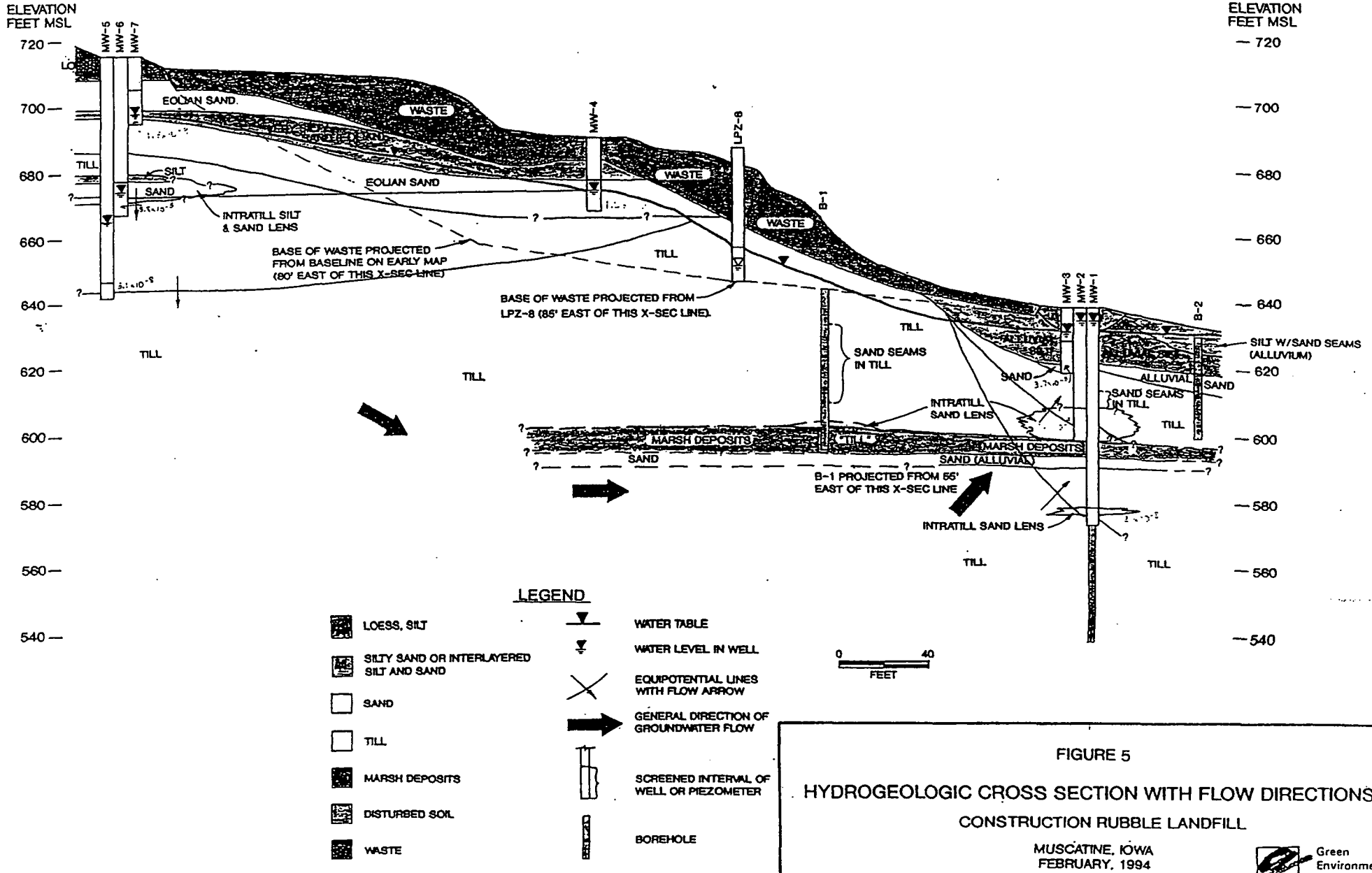


FIGURE 5

HYDROGEOLOGIC CROSS SECTION WITH FLOW DIRECTIONS

CONSTRUCTION RUBBLE LANDFILL

MUSCATINE, IOWA
FEBRUARY, 1994

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CONSTRUCTION RUBBLE LANDFILL
MUSCATINE, IOWA

FEBRUARY, 1994

TABLE 2. WATER LEVEL DEPTHS AND ELEVATIONS

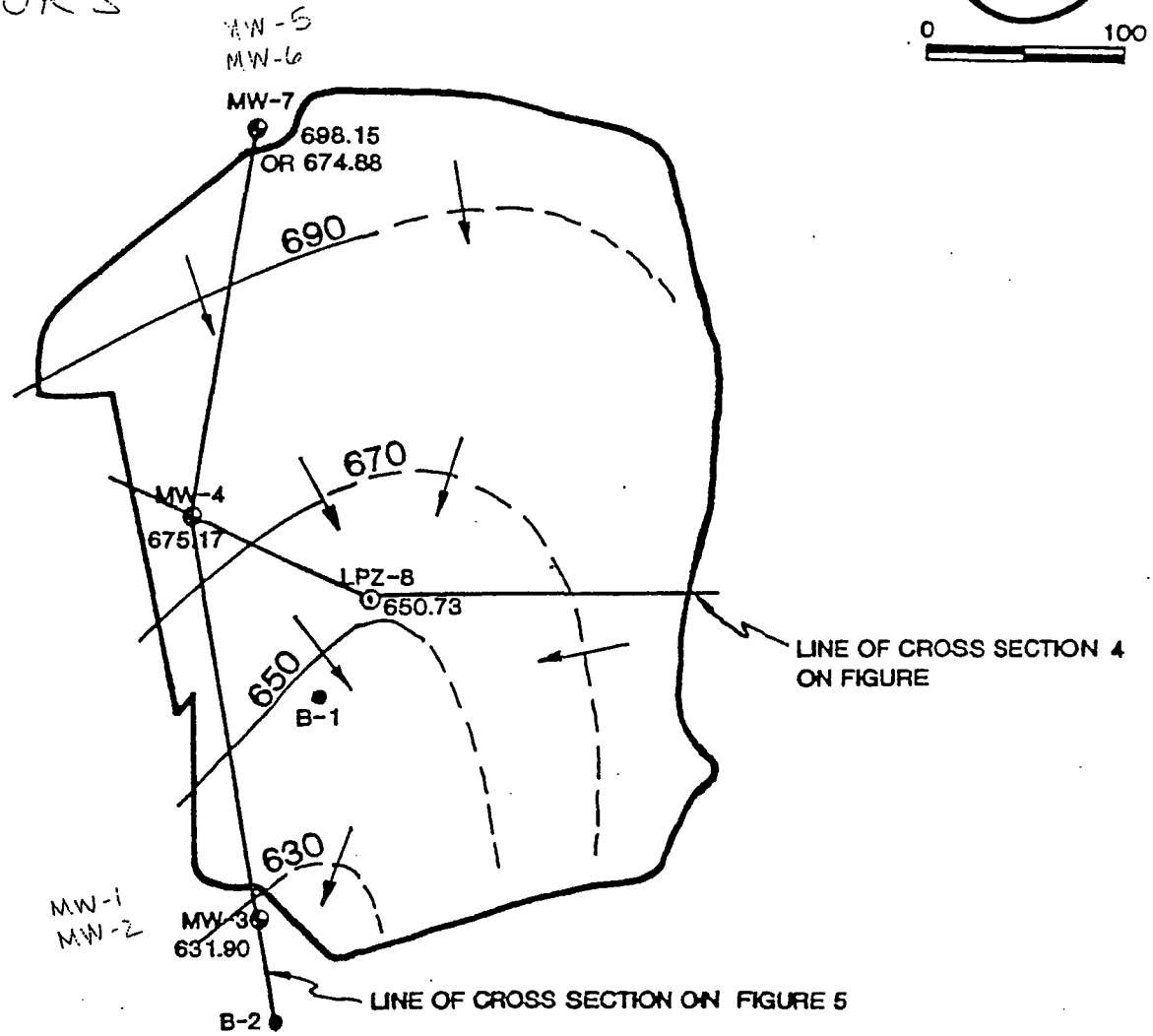
A. DEPTHS, IN FEET, MEASURED FROM TOP OF CASING

WELL #	11/4/93	11/23/93	12/9/93	12/16/93	1/20/94
MW-3	7.08	7.24	7.53	7.62	8.46
MW-2	6.24	6.05	6.10	7.71	6.40
MW-1	66.64	5.60	5.64	6.22	5.97
MW-4	16.44	16.94	17.20	17.49	18.05
MW-7	16.35	16.72	17.15	17.70	18.50
MW-6	39.38	48.94	40.76	41.05	41.75
MW-5	70.75	57.04	53.54	52.57	50.95
LPZ-8	42.05	42.30	---	---	42.26

B. WATER LEVEL ELEVATIONS, IN FEET MSL.

WELL #	TOC Elev.	11/4/93	11/23/93	12/9/93	12/16/93	1/20/94
MW-3	640.36	633.28	633.12	632.83	632.74	631.90
MW-2	640.86	634.62	634.81	634.76	633.15	634.46
MW-1	640.42	573.78	634.82	634.78	634.20	634.45
MW-4	693.22	676.78	676.28	676.02	675.73	675.17
MW-7	716.65	700.30	699.93	699.50	698.95	698.15
MW-6	716.63	677.25	667.69	675.87	675.58	674.88
MW-5	716.80	646.05	659.76	663.26	664.23	665.85
LPZ-8	692.99	650.94	650.69	---	---	650.73

WATER TABLE CONTOURS



LEGEND

- MONITORING WELL
- LEACHATE PIEZOMETER
- SOIL BORING
- WATER TABLE CONTOUR WITH FLOW ARROW
- APPROXIMATE WASTE BOUNDARY

FIGURE 6

WATER TABLE CONTOUR MAP

CONSTRUCTION RUBBLE LANDFILL

MUSCATINE, IOWA
FEBRUARY, 1994

Green Environmental Services, Inc.

CJZ714520J/0610

Hydraulic Properties

1. Hydraulic gradients are presented in Table 3. Horizontal gradients were obtained from the potentiometric map of the water table (Figure 6). Horizontal hydraulic gradients measure the steepness of the water table. These gradients vary from 0.122 to 0.299. Directions converge toward the ravine.

Vertical hydraulic gradients are also presented in Table 3. Head differences were calculated for shallow to mid-level and mid-level to deep wells in the triple clusters, with the exception of the gradient between MW-6 and MW-7. There is a discontinuity in the saturated zone within the sand screened by MW-6, which prevents calculation of a vertical gradient for this well pair. The overall gradient was calculated between MW-1 and MW-3. Vertical gradients varied from 0.0 to 0.351. The direction is downward for the upgradient cluster.

On January 20, 1994, the water levels in MW-1 and MW-2 varied by 0.01 feet, which is within the limit of measurement of + or - 0.01 feet. Thus, there was no tendency for vertical movement between these two wells. However, both wells had a higher water level than MW-3, the shallow well. Thus, there was an upward gradient for each well compared to MW-3, as portrayed on Figure 5. Vertical gradients for December 16, 1993 are also presented. On that date, the typical upward gradient between MW-1 and MW-2 was present.

The numerical values of hydraulic gradients are important for use in calculations. However, to visualize the three-dimensional flow pattern, it is better to refer to the cross sections and map in Figures 4 through 6.

2. Laboratory hydraulic conductivities (permeabilities) are presented in Table 4 and Appendix F. These were determined by means of a constant head test on an undisturbed sample. The samples for laboratory tests were taken from a cohesive sediment below the depth of waste disposal except for MW-4, where no suitable

CONSTRUCTION RUBBLE LANDFILL
MUSCATINE, IOWA

FEBRUARY, 1994

TABLE 3. HYDRAULIC GRADIENTS

A. HORIZONTAL HYDRAULIC GRADIENTS (i_h)

WELL NUMBER	i_h on 1/20/94	DIRECTION
MW-3	0.259	Southeast
MW-4	0.191	Southeast
MW-7	0.122	South Southeast
LPZ-8	0.299	South

B. VERTICAL HYDRAULIC GRADIENTS (i_v)

WELL PAIRS	i_v on 12/16/93	DIRECTION	i_v on 1/20/94	DIRECTION
MW-2 to MW-3	0.021	Upward	0.131	Upward
MW-1 to MW-2	0.038	Upward	0.000	Horizontal
MW-1 to MW-3	0.031	Upward	0.054	Upward
MW-6 to MW-5	0.351	Downward	0.285	Downward

CONSTRUCTION RUBBLE LANDFILL
MUSCATINE, IOWA

FEBRUARY, 1994

TABLE 4. HYDRAULIC CONDUCTIVITIES (K)

A. LABORATORY HYDRAULIC CONDUCTIVITIES
(Measured by a constant head test on an undisturbed sample)

WELL NO.	DEPTH IN FEET	K in cm/s	SEDIMENT TYPE
MW-1	62-63	1.8×10^{-8}	Till
MW-5	33-34	3.0×10^{-9}	Till
LPZ-8	45-46	4.4×10^{-9}	Till

B. IN-SITU HYDRAULIC CONDUCTIVITIES
(Measured by a bail test)

WELL NO.	SCREEN DEPTH IN FEET	K in cm/s	SEDIMENT TYPE
MW-3	10-20	3.7×10^{-3}	Alluvial Silt and Sand
MW-2	30-40	1.6×10^{-4}	Intratill Sand Lens
MW-1	60-65	2.0×10^{-5}	Intratill Sand Lens
MW-4	12.5-22.5	1.5×10^{-3}	Eolian Sand
MW-7	10-20	1.3×10^{-3}	Eolian Sand
MW-6	37-47	5.8×10^{-5}	Intratill Sand Lens
MW-5	69-74	3.1×10^{-8}	Till

sample was available. Values varied from 3.0×10^{-9} to 1.8×10^{-8} centimeters per second (cm/s). All samples were till. These values indicate a very low permeability.

In-situ hydraulic conductivities were determined by means of bail tests. The results are presented in Table 4 and Appendix F, along with a description of the saturated and/or most permeable sediment in the screened interval. Where small, isolated sand lenses are surrounded by till, groundwater movement depends on the conductivity of the till and the surface area of the contact between sand and till as well as the conductivity of the sand. When wells are screened across both sand and till, the measured value is intermediate between the conductivity of the sand and till.

Hydraulic conductivities for intratill sand lenses varied from 2.0×10^{-5} to 1.6×10^{-4} cm/s. The conductivities for eolian sand were 1.3×10^{-3} and 1.5×10^{-3} cm/s. The conductivity for alluvial silt over sand was 3.7×10^{-3} cm/s.

A bail test run for 110 minutes on MW-5 resulted in a hydraulic conductivity of 1.6×10^{-5} cm/s, which appeared to be too high for a well which needed 2.5 months to stabilize or nearly stabilize. The continuous samples from the borehole were clay-rich till throughout the screened interval. Therefore, five water level measurements taken over this time period were analyzed to obtain a hydraulic conductivity of 3.1×10^{-8} cm/s. According to LaDon Jones of Iowa State University (personal communication), this is a valid procedure after the well has stabilized. The difference in results is due to the effect of the developed zone around the well during the relatively short bail test procedure (Bouwer, 1989) (Jones, 1993). If the bail test had been extended to 24 or 48 hours, similar results would have been obtained.

This low in-situ hydraulic conductivity of 3.1 X 10^{-8} cm/s for the glacial till demonstrates that the till will prevent downward flow into the bedrock aquifer. The till below a depth of 65 feet in the boring for MW-1 is likely to have an even lower permeability because it was too dense to drill with hollow stem augers and required rotary drilling.

3. A common form of Darcy's Law is Q = K*i*A, where Q is the flow rate, K is the hydraulic conductivity, i is the hydraulic gradient, and A is the cross sectional area of inflow (Freeze and Cherry, 1979). Horizontal and vertical flow rates for one square foot of area are presented in Table 5. The horizontal flow rates were calculated using the horizontal gradients and in-situ hydraulic conductivities for the water table wells. The vertical flow rates for MW-5 and MW-6 were calculated using the vertical gradient and the lower in-situ hydraulic conductivity for each pair. The lower conductivity is used because sediments with lower conductivity will restrict the groundwater flow. However, the true flow rates may be less than calculated for the cluster including MW-1, MW-2, and MW-3, since the hydraulic conductivities of the intervening till units are unknown. No vertical hydraulic gradient nor vertical flow rate was calculated for MW-6 and MW-7 due to the discontinuity of the saturated zone where part of the sand lens is dry (unsaturated) within the screened interval of MW-6.

The horizontal flow rates vary from 0.882 to 5.358 f^3/d. Upward flow rates between MW-2 and MW-3 were 0.019 and 0.120 on two separate days. The upward flow rates between MW-1 and MW-2 were 0.0 and 0.004. The vertical flow rates, directed downward, at MW-5 and MW-6 are 2.5 X 10^{-5} and 3.1 X 10^{-5} f^3/d. The vertical flow rates are less than the horizontal. Vertical flow rates decrease with depth. Thus, there is a strong tendency for the groundwater to flow laterally in the shallow sediments.

CONSTRUCTION RUBBLE LANDFILL
MUSCATINE, IOWA

FEBRUARY, 1994

TABLE 5. GROUNDWATER FLOW RATES AND TRANSMISSIVITIES

A. HORIZONTAL FLOW RATES (Q_h)

WELL NO.	Q_h on 1/20/94 in f^3/d	DIRECTION
MW-3	5.358	Southeast
MW-4	1.630	Southeast
MW-7	0.882	South Southeast

B. VERTICAL FLOW RATES (Q_v)

WELL PAIR	Q_v on 12/16/93 in f^3/d	DIRECTION	Q_v on 1/20/94 in f^3/d	DIRECTION
MW-2 to MW-3	0.019	Upward	0.120	Upward
MW-1 to MW-2	0.004	Upward	0.000	Horizontal
MW-6 to MW-5	3.1×10^{-5}	Downward	2.5×10^{-5}	Downward

C. TRANSMISSIVITIES (T)

WELL NO.	AQUIFER THICKNESS IN FEET	T in f^2/d	SEDIMENT TYPE
MW-3	11.5	237.9	Alluvial Silt and Sand
MW-2	10	9.16	Intratill Sand Lens
MW-1	2	0.23	Intratill Sand Lens
MW-4	9	76.8	Eolian Sand
MW-7	12.5	90.35	Eolian Sand
MW-6	4.5	1.47	Intratill Sand Lens
MW-5	8*	0.0007	Till

* Length of sandpack

4. Transmissivity is defined as the hydraulic conductivity multiplied by the aquifer thickness. For unconfined aquifers, only the saturated thickness is considered. Transmissivities are often reported for aquitards, however, the hydraulic conductivity has more significance. The transmissivities have been calculated using in-situ hydraulic conductivities. The highest transmissivity, for alluvium, is 237.9 f^2/d (Table 5). The transmissivities for eolian sand are 76.8 and 90.35 f_2/d. Transmissivities for intratill sand lenses vary from 0.23 to 9.16 f^2/d. The transmissivity for deep till is 0.0007 f^2/d. These transmissivities show a progression from higher transmissivities for shallow to lower transmissivities for deep sediments varying over 6 orders of magnitude. According to Driscoll (1986), a good aquifer for domestic use should have a transmissivity greater than 1400 f^2/d, and an aquifer used for a municipal water supply, industry, or irrigation should have a transmissivity greater than 14,000 f^2/d. None of the sediments at the landfill site would be suitable as a water supply aquifer, even for domestic purposes.

5. Storage coefficient or specific yield can only be determined from wells where pumping tests can be conducted (Freeze and Cherry, 1979). This would involve pumping one well and noting drawdown in other wells screened in the same aquifer. No such data are available for the landfill site.

Designation of Aquitards and Aquifers

Groundwater flow lines and equipotential lines are refracted at a geologic contact where the hydraulic conductivities vary (Freeze and Cherry, 1979). Flow tends to be nearly horizontal in materials with high conductivity and nearly vertical in materials with low conductivity. The larger volume of water would flow laterally in the material with larger conductivity and a smaller volume would move vertically through the material with a low conductivity. This

information, derived from consideration of groundwater flow theory, along with the hydraulic properties calculated for sediments at the landfill, allow designation of aquifers and aquitards.

The deeper part of the glacial till is an aquitard. This is shown by the low in-situ hydraulic conductivity, flow rate, and transmissivity measured at MW-5 and the nearly vertical flow paths at MW-5 and MW-6. The need to use rotary drilling below 65 feet at MW-1 suggests high density and low conductivity for the deep till at that location.

The eolian sand at MW-4 and MW-7 and the alluvial sequence at MW-3 are aquifers, as shown by the higher hydraulic conductivities, flow rates, and transmissivities. The shallow till with sand seams and lenses encountered at B-1 and MW-1 at shallow depths has an intermediate hydraulic conductivity, flow rate, and transmissivity. It is likely that the shallow till, with or without sand lenses, functions as an aquifer compared to the deep till. At many other sites, shallow weathered till has a conductivity on the order of 10^{-6} cm/s. The yellow brown color of the shallow till at the MW-5 location and at LPZ-8 is a symptom of weathering. The shallow till at the MW-1 location had sand fracture fills, which indicates weathering, but the constant saturated condition below the ravine prevented formation of the yellow brown color. Shallow weathered till likely extends below the entire ravine under the eolian sand and alluvium. Any contaminated groundwater moving out of the waste would move laterally through the alluvium and weathered till. The eolian sand, alluvium, and weathered till with or without sand lenses form the uppermost aquifer. The water table is situated within this aquifer.

Water Table and Uppermost Aquifer are same unit.

Conclusions of the Investigation

1. Horizontal flow paths converge toward the ravine.

2. Vertical flow paths in the till are downward upgradient from the landfill, nearly horizontal at midslope, then upward toward the base of the ravine.

3. The eolian sand, alluvium, and upper till form the uppermost aquifer. The deep till functions as an aquitard.

4. The water table is situated in the uppermost aquifer.

5. There are no intermittent streams nor permanent streams on the landfill property, though the drainage way in the ravine downhill from the landfill would contain flowing water after heavy precipitation or snowmelt.

HMSP PROPOSAL

PART IV

HYDROLOGIC MONITORING SYSTEM PLAN

Introduction

In light of the conclusions of the investigation, no surface water monitoring is needed, and the following wells should be monitored: MW-2, MW-3, MW-4, MW-6, and MW-7. Wells MW-1 and MW-5 will be used as water level measuring points. The letter of October 15, 1993 from IDNR provided a waiver to the minimum requirement of three downgradient water table wells due to the small size of the landfill and severe access restrictions. An evaluation of each monitoring well is provided below.

Locations of Monitoring Wells

MW-1. This well is screened from 60 to 65 feet, across a 2-foot sand lens in the deep till aquitard. It will not be monitored, but will be used as a water level monitoring point.

MW-2. This well is screened from 30 to 40 feet across a 10-foot intratill sand lens. It is downgradient. The material between this sand lens and the overlying alluvium is as follows: There are 1.5 feet of till with sand fracture fill immediately below the alluvium, 5 feet of till with no sand seams, and 5 feet of till with sand seams. The till is likely to be weathered, and the sand seams could interconnect away from the borehole. Therefore, this well should be monitored as an uppermost aquifer well.

MW-3. This well is screened from 10 to 20 feet in alluvium, which includes silt over 1.5 feet of sand. The silty alluvium forms the base of the waste-filled ravine. This is also a downgradient uppermost aquifer and water table well, toward which the shallow groundwater flow converges. It will be monitored.

MW-4. This well was drilled through 6.5 feet of waste near the west boundary of the waste. It is screened from 12.5 to 22.5 in very silty eolian sand and non-silty eolian sand. It is an uppermost aquifer and water table well that is downgradient from the northwest portion of the landfill. It will be monitored.

MW-5. This well is screened from 69 to 74 feet in the deep till aquitard. It will not be monitored, but will be used as a water level measuring point.

MW-6. This well is screened in from 37 to 47 feet across a 7-foot intratill sand lens and 3 feet of till. It is possible that this sand unit could be continuous to the waste boundary. Therefore, this well should be monitored as an uppermost aquifer well. It is in an upgradient position, but if it is continuous with the waste, it could be downgradient, depending on the hydraulic head of the saturated zone within the waste. Even though it is likely to be upgradient, it should not be used as a baseline well for purposes of statistical analysis of monitoring results.

MW-7. This wells is screened from 10 to 20 feet in very silty eolian sand and non-silty eolian sand. It is an upgradient uppermost aquifer and water table well. It will be monitored and used as the baseline well for statistical purposes.

Operational Plan For The Monitoring System

Chemical Parameters

During the first year of operation of the hydrologic monitoring system, samples will be collected quarterly from each monitoring well. Samples will be analyzed for the lists of parameters in 103.2(4) "d" and "e", to be called "list d" and "list e" below.

After the first year, samples will be collected semiannually and analyzed for the parameters listed in 103.2(4) "e".

An annual water-quality report will be submitted to IDNR with the semi-annual engineering inspection report, by November 30 of each year, after the quarterly sampling is complete. The water quality report will summarize the effect the facility is having on groundwater quality. The report will discuss any changes or maintenance that are needed for the monitoring system. The report will include graphs for all chemical parameter concentrations versus time for each well. The control limits will be shown on the graphs. Results of activities and tests required by the well maintenance and reevaluation plan will be submitted with the report.

Sampling Protocol

A document titled "Procedure for Groundwater and Surface Water Sampling, Green Environmental Services, Inc., Cedar Rapids, Iowa, March, 1994" is included in Appendix G. An addendum to this standard protocol, as requested by Rob McDonald of the City of Muscatine on March 23, 1994, is presented in Appendix H. These documents discuss procedures to be used when sampling of monitoring wells is done at the City of Muscatine Construction Rubble Landfill. Duplicate and replicate samples and equipment blanks will not be analyzed unless required by IDNR, according to 103.2(7) I.A.C. If these are required, then procedures described in the protocol will be followed. MW-7 is upgradient and must be sampled first. The other wells should be sampled in the following order: MW-6, MW-4, MW-2, MW-3. Water levels will be measured in wells when samples are collected. Down gradie

APPENDIX C

LOGS AND DOCUMENTATION FORMS FOR MW-1 THROUGH MW-7 & LOG FOR EPZ-8

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70 -SDP-4- 78 P
Well or Piezometer # MW-1 Date started 10/25/93 Date completed 10/27/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7028.2 N
Distance and direction from boundary to well 10480.6 E

Elevations (±0.01 ft. MSL):
Ground surface 638.70
* Top of protective casing 640.41
Top of well casing 640.42
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method HSA to 65 Rotary to 100
Drilling fluid Drilling mud for rotary
Bore hole diameter 9" to 65, 4" to 100
Soil sampling method **
Depth of boring 100.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 61.72'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 5.0'
Depth of well 67.09'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 3.0 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite grout
Placement method Tremied
Volume 21.8 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing) 634.45 on 1/20/94
Stabilization time <1 month
Well development method Pneumatic bailer, used until water is clear

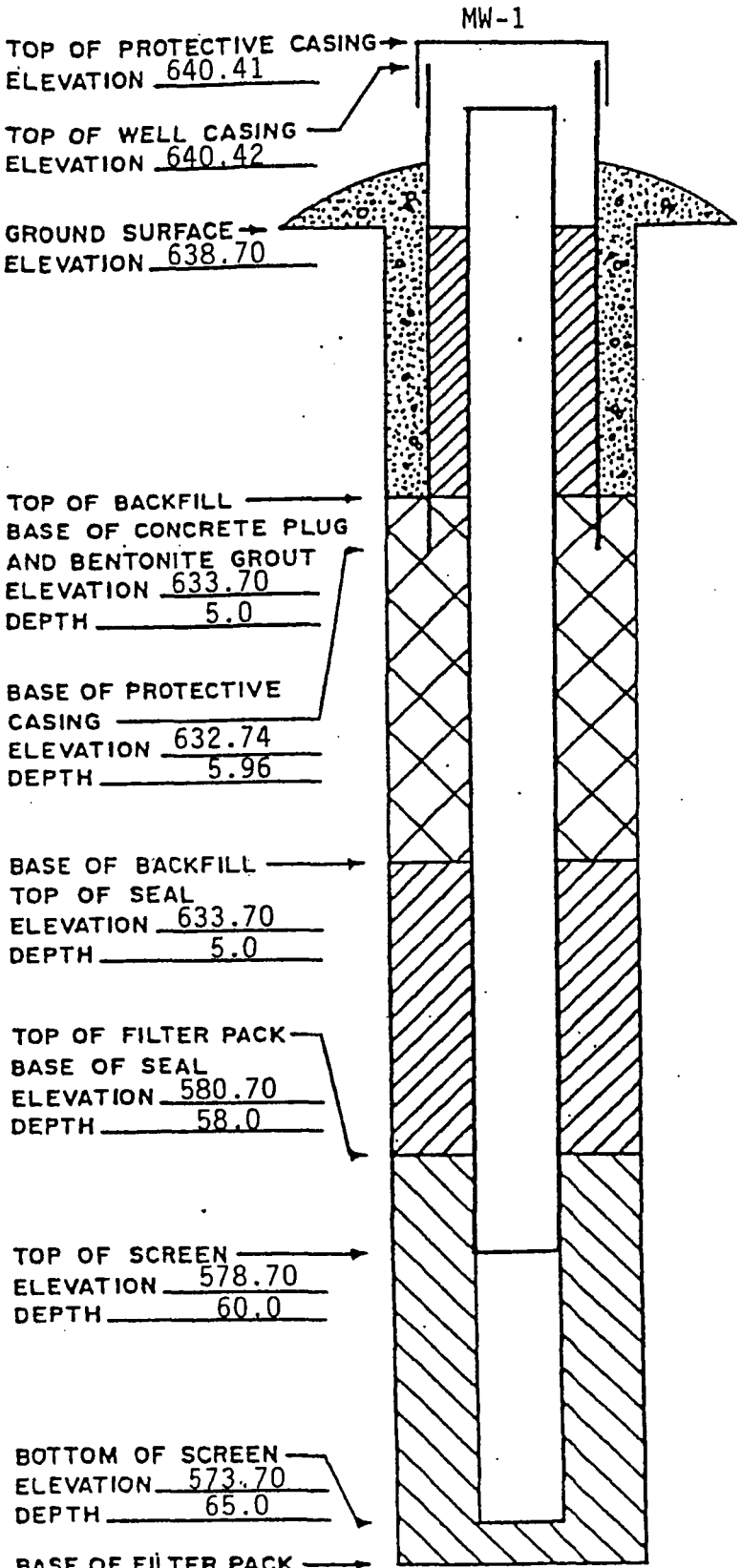
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Downgradient
Average depth of frostline 30"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring well and piezometers.

Form #542-127

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL



Bentonite Seal from 67.0 to 100.0 Depth

5-420-1607
314-331-2427

field boring log

Project: Muscatine C+D Land-Fill

Boring No. MW-1 Date Started 10-25-93 Date Complete 10-27-93

Drilled by Jay Troy Logged by Jay Rig ORV-57

1st 10-25
2nd 30-40

subsurface stratigraphy

☐ 4" Flight Augers ☐ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
0	7.0±	Brown & Clay w/ Organics w/ Brick & Concrete "FILL"
7.0	14.0±	DK Brown & Clay w/ Fine Sand
14.0	16.0±	Grey Fine - Med Sand w/ Silt
16.0±	24.0	Olive Green & Clay w/ Sand & Gravel
24.0	31.0	DK Grey & Clay w/ Sand & Gravel w/ Dry Sand Lenses
31.0	37.0±	Grey Fine to Med Sand w/ water
37.0±	41.0±	Grey Fine Sand w/ Silt
41.0±	60.0	DK Grey & Clay & Clay w/ Sand & Gravel
60.0	62.0	Grey Fine-Med Sand
62.0	70.0	Grey & Clay w/ Sand & Gravel

Bottom of Boring 100.0

water levels

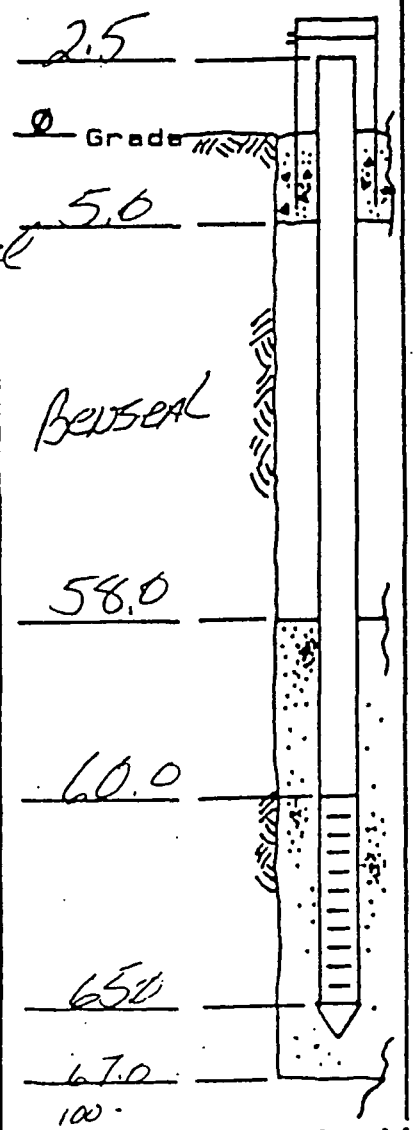
___ While Drilling

___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☐ Stick-up Cover
☐ Flush Cover



sample data

Depth	Number/Type	Depth	Number/Type
0-5	1-CS	50-55	11-CS
5-10	2-CS	55-60	12-CS
10-15	3-CS	60-65	13-CS
15-20	4-CS	65-70	14-RS
20-25	5-CS	70-75	15-RS
25-30	6-CS	75-80	16-RS
30-35	7-CS	80-85	17-RS
35-40	8-CS	85-90	18-RS
40-45	9-CS	90-95	19-RS
45-50	10-CS	45-100	20-RS

CS = Continuous Sampler AS = Auger Sample

aquadrill

field boring log

Page # 2 of 2

Project: Musgrave C&D

Boring No. HW-1 Date Started 10-25-93 Date Complete 10-27-93

Drilled by Jay & Troy Logged by Jay Rig CKU-57

subsurface stratigraphy

☐ 4" Flight Augers ☐ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
NC	82.0	Grey Med-Coarse Sand & Gravel
82.0		Grey & Clay w/ Sand & Gravel "Till"
0	65.0	4¼ H.S. Auger
65.0	100.0	Mud Rotary w/ 4⅛" Tri-Cone

Bottom of Boring 100.0

water levels

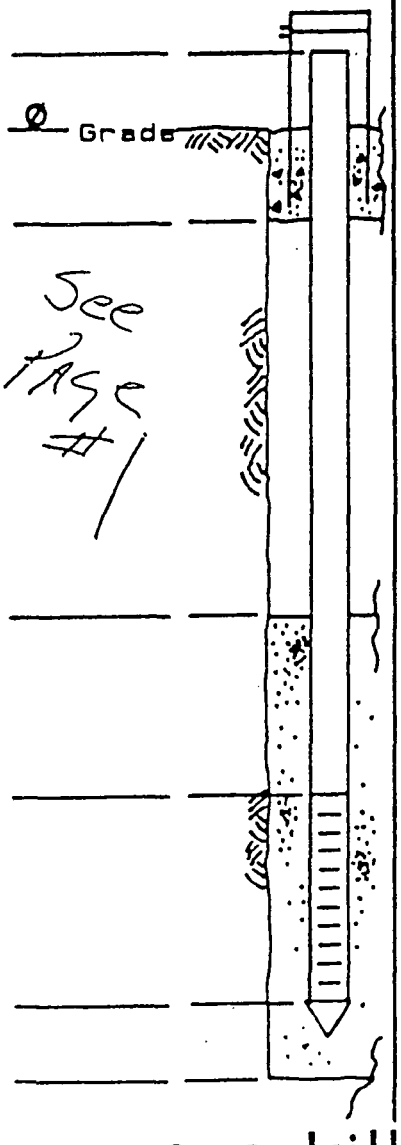
___ While Drilling

___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☐ Stick-up Cover
☐ Flush Cover



See Page #1

sample data

Depth	Number/Type	Depth	Number/Type

CS = Continuous Sampler AS = Auger Sample

aquadrill

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70-SDP-4-78
Well or Piezometer # MW-2 Date started 10/27/93 Date completed 10/28/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7023.3 N
Distance and direction from boundary to well 10484.3 E

Elevations (±0.01 ft. MSL):
Ground surface 638.70
* Top of protective casing 640.89
Top of well casing 640.86
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method Hollow stem auger
Drilling fluid None
Bore hole diameter 9"
Soil sampling method **
Depth of boring 41.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 32.16'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 10.0'
Depth of well 40.95'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 5.3 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite grout
Placement method Tremied
Volume 9.5 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing) 634.46 on 1/20/9
Stabilization time <1 week
Well development method Pneumatic bailer, used until water is clear

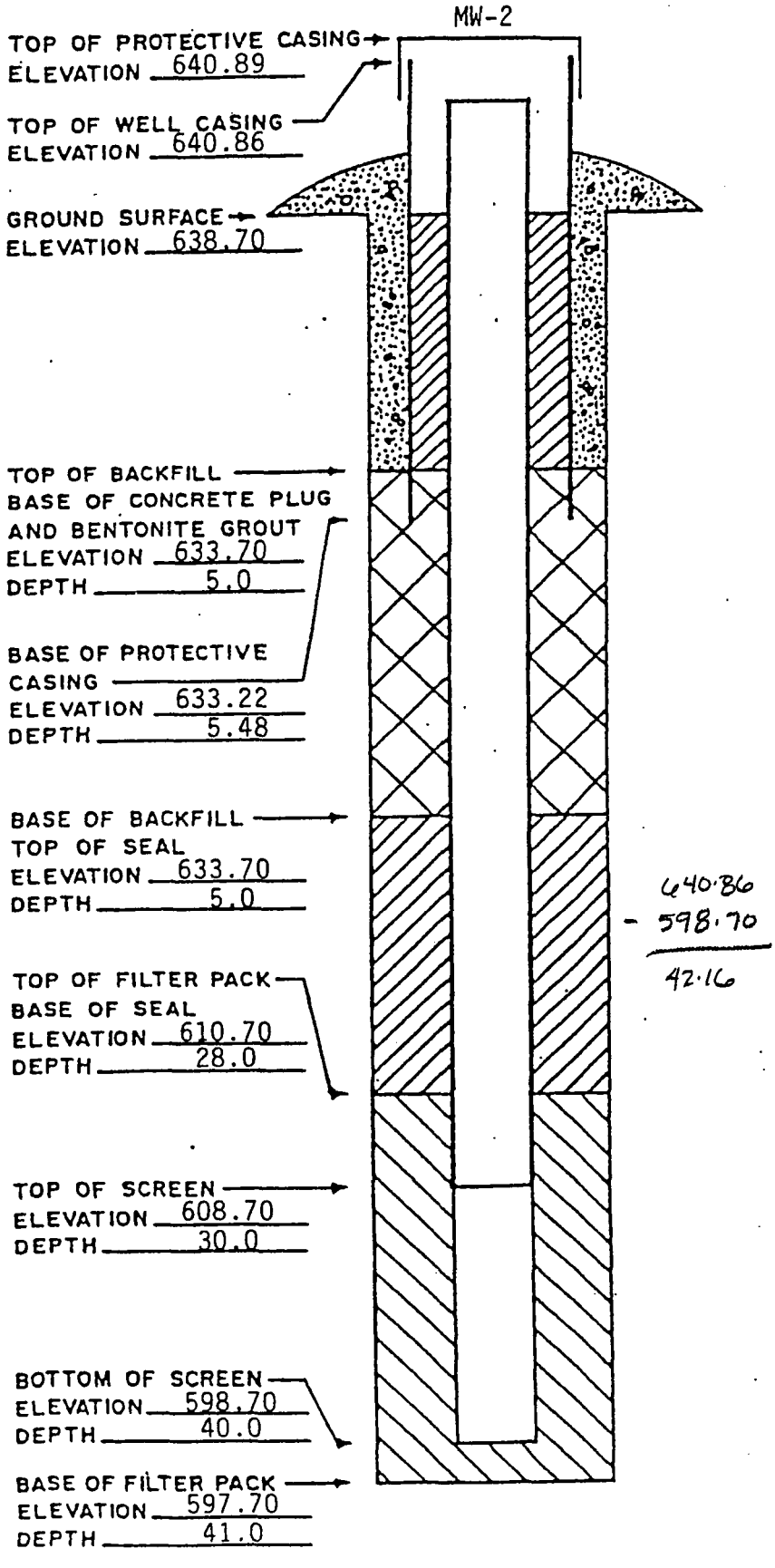
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Downgradient
Average depth of frostline 30"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring well and piezometers.

Form #542-12

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTA(ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL



640.86
- 598.70
42.16

field boring log

Project: Muscatine C+D Landfill

Boring No. MW-2 Date Started 10-27-93 Date Complete 10-28-93

Drilled by JAY + Tom Logged by JAY Rig ORU-57

subsurface stratigraphy

☐ 4" Flight Augers ☑ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
		See MW-1 for Soils Log
0	7.0	Hard drilling Brick Concrete wood
		Bottom of Boring 41.0

water levels

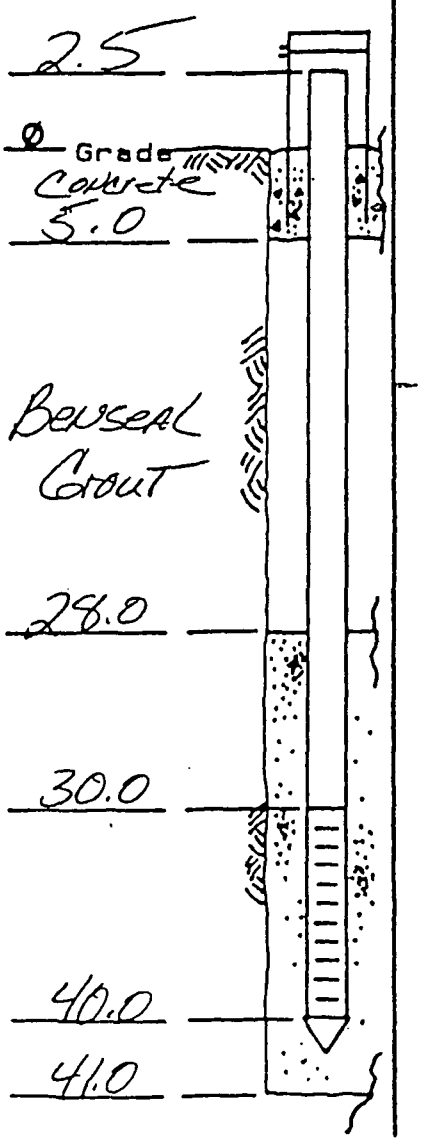
— While Drilling

— 0 Hours A.B.

— — Hr. A.B.

well details

☑ Stick-up Cover
☐ Flush Cover



sample data

Depth	Number/Type	Depth	Number/Type
	NO Sampling		

CS = Continuous Sampler AS = Auger Sample

aquadrill

MONITORING WELL / PIEZOMETER CONSTRUCTION DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70 -SDP-4- 78
Well or Piezometer # MW-3 Date started 10/28/93 Date completed 10/28/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7023.7 N
Distance and direction from boundary to well 10479.9 E

Elevations (±0.01 ft. MSL):
Ground surface 638.30
* Top of protective casing 640.37
Top of well casing 640.36
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method Hollow stem auger
Drilling fluid None
Bore hole diameter 9"
Soil sampling method **
Depth of boring 21.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 12.06'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 10.0'
Depth of well 22.82'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 5.3 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite granules
Placement method Poured
Volume 1.2 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing) 631.90 on 1/20/94
Stabilization time <1 week
Well development method Pneumatic bailer, used until water is clear

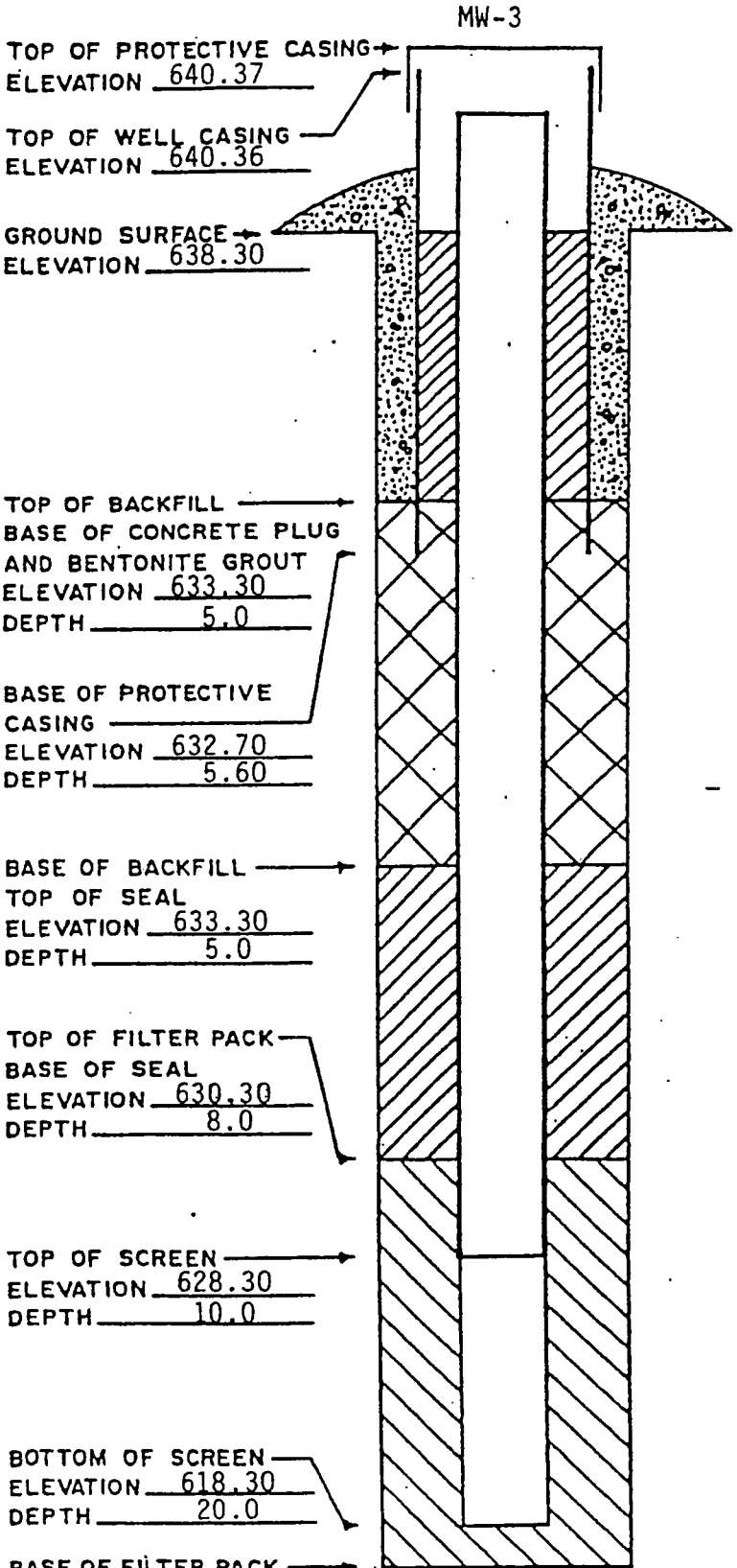
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Downgradient
Average depth of frostline 30"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-127

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTA ENTIRE SOIL BORING LOG
(SHOW SCREENED INTERVAL AND FILTER PACK INTERVAL



640.36
− 618.30
22.06

field boring log

Project: Muscatine C+D Landfill

Boring No. MW-3 Date Started 10-28-93 Date Complete 10-28-93

Drilled by Jay & Troy Logged by Jay Rig CKU-57

subsurface stratigraphy

☐ 4" Flight Augers ☒ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
		See MW-1 For Soils Log
0	7.0	Hard drilling Brick Concrete

Bottom of Boring 21.0

water levels

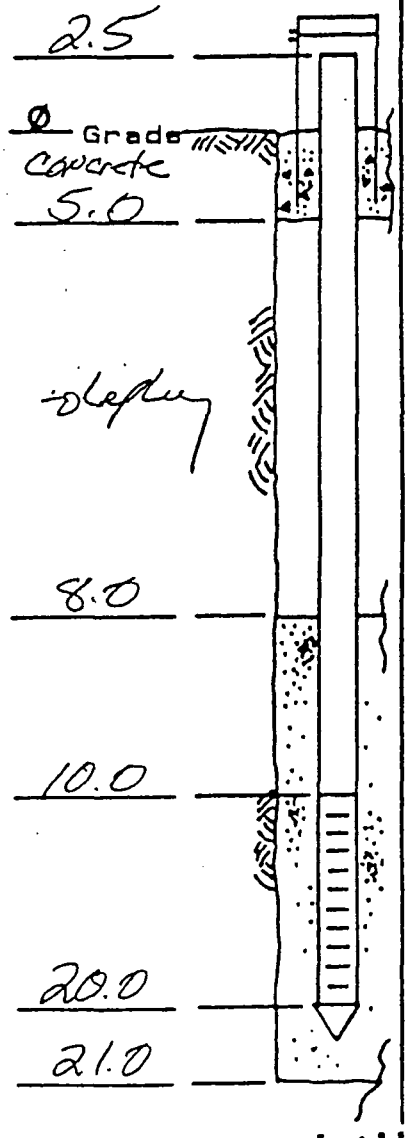
___ While Drilling

___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☒ Stick-up Cover
☐ Flush Cover

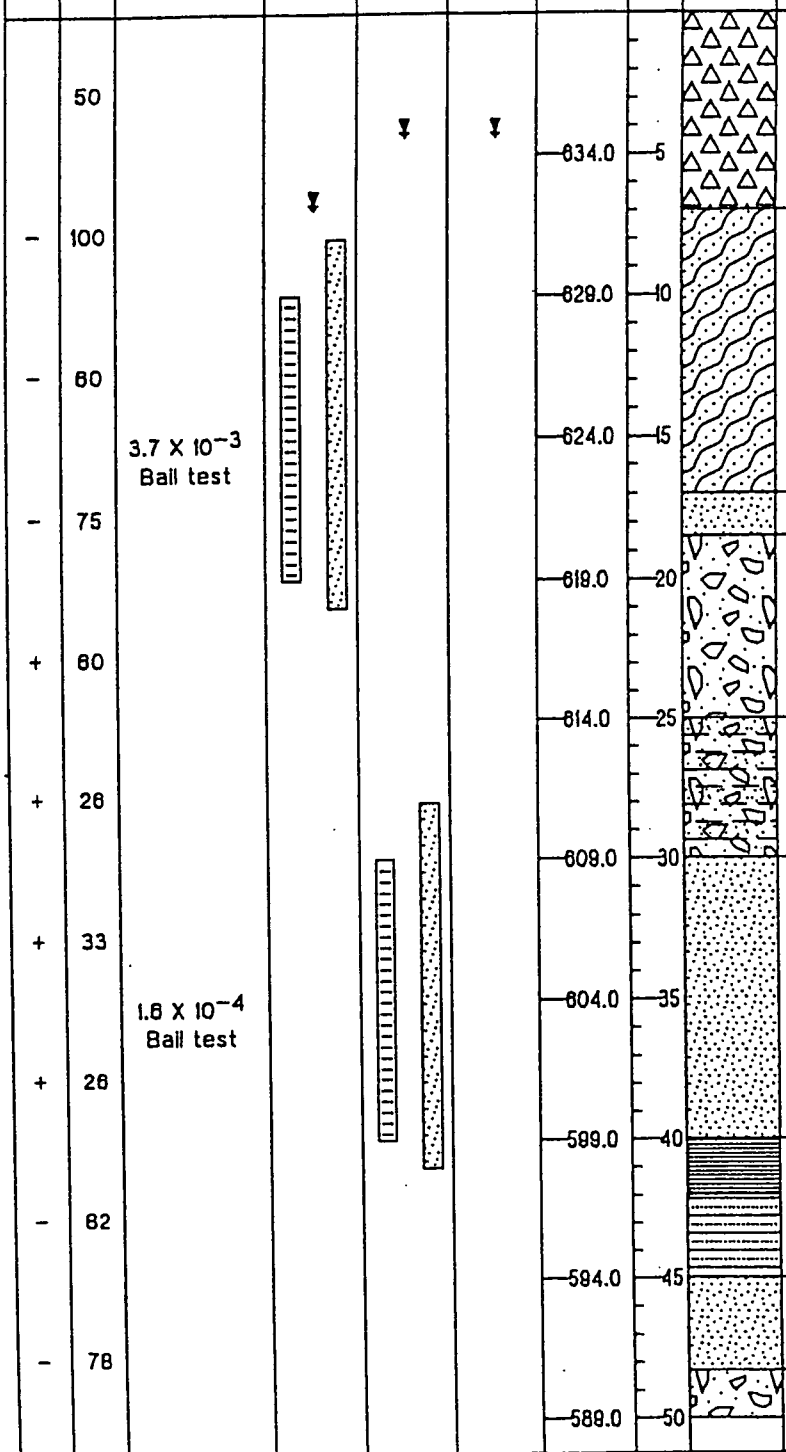


sample data

Depth	Number/Type	Depth	Number/Type
	NO SAMPLING		

CS = Continuous Sampler AS = Auger Sample

aquadrill



MATERIALS DESCRIPTION

0 to 7 FILL
Sandy silty clay. Yellow brown and dark brown, mottled. Disturbed material. Minor content of brick fragments.

7 to 17 SILTY ALLUVIUM
Sandy clayey silt, trace gravel. Leached. Dark brown from 7 to 8 feet. Topsoil. Medium gray from 8 to 17 feet, with yellow to orange brown oxidized mottles below 15 feet.

Transitional contact to underlying unit.

17 to 18.5 SANDY ALLUVIUM
Very silty, fine to medium sand. Dark gray. Leached.

18.5 to 25 SANDY TILL
Clayey silty sand, trace gravel. Dark gray. Leached from 18.5 to 20 feet. Diagonal sand seams within interval from 20 to 21.5 feet, fracture fill. Seams are 1/16 to 1/2 inches thick. Unleached below 20 feet.

25 to 30 TILL WITH INTRATILL SAND SEAMS
Sandy silty clay, trace gravel. Dark gray. Unleached. Due to sample loss, the number and thickness of sand seams are unknown. Sand is light gray, fine, unleached.

30 to 40 INTRATILL SAND LENS
Recovered portion is very silty, very fine sand. Medium gray, unleached.

40 to 45 MARSH DEPOSITS
Organic silty clay, with plant fragments from 40 to 42 feet. Very dark gray. Leached. Interlayered sand and organic silty clay below 42 feet. Sand is medium gray, very fine, leached. 2" organic layers at 42.8 and 43.5 ft

45 to 48 SAND
Silty, very fine sand. Light gray. Leached. May be alluvium associated with overlying marsh deposits.

PROJECT Construction Rubble Landfill
PROJECT NUMBER 714520-J
SURFACE ELEVATION 638.7 Feet MSL
TOTAL DEPTH OF HOLE 100.0 Feet

LOG OF MW-1, MW-2, MW-3

LOCATION Muscatine, Iowa
GEOLOGIST Barbara Torney

CaCO3	% RECOVERY	K (cm/sec)	MW-3	MW-2	MW-1	ELEVATION (ft. msl)	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
+	22					584.0	55		48 to 60 TILL Sandy silty clay, trace gravel. Dark gray. Leached from 48 to 50 feet. Unleached below 50 feet.
+	26								
						579.0	60		60 to 62 INTRATILL SAND LENS Silty, fine to medium sand. Medium gray. Unleached.
+	76	2.0×10^{-5} Bail test 1.8×10^{-8} Laboratory				574.0	65		62 to 100 TILL Sandy clayey silt, trace gravel. Dark gray. Unleached. Bag samples from mud rotary drilling below 65.0 feet.
						569.0	70		
						564.0	75		
						559.0	80		
						554.0	85		
						549.0	90		
						544.0	95		
						539.0	100		Bottom of borehole at 100.0 feet.

PROJECT Construction Rubble Landfill
PROJECT NUMBER 714520-J
SURFACE ELEVATION 638.7 Feet MSL
TOTAL DEPTH OF HOLE 100.0 Feet

LOG OF MW-1, MW-2, MW-3
LOCATION Muscatine, Iowa
GEOLOGIST Barbara Torney

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70 -SDP-4- 78
Well or Piezometer # MW-4 Date started 10/28/93 Date completed 10/29/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7229.9 N
Distance and direction from boundary to well 10445.3 E

Elevations (±0.01 ft. MSL):
Ground surface 691.29
* Top of protective casing 693.23
Top of well casing 693.22
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method Hollow stem auger
Drilling fluid None
Bore hole diameter 9"
Soil sampling method **
Depth of boring 23.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 14.43'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 10.0'
Depth of well 25.04'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 5.1 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite granules
Placement method Poured
Volume 2.3 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing) 675.17 on 1/20/94
Stabilization time <1 week
Well development method Pneumatic bailer, used until water is clear

Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Downgradient
Average depth of frostline 30"

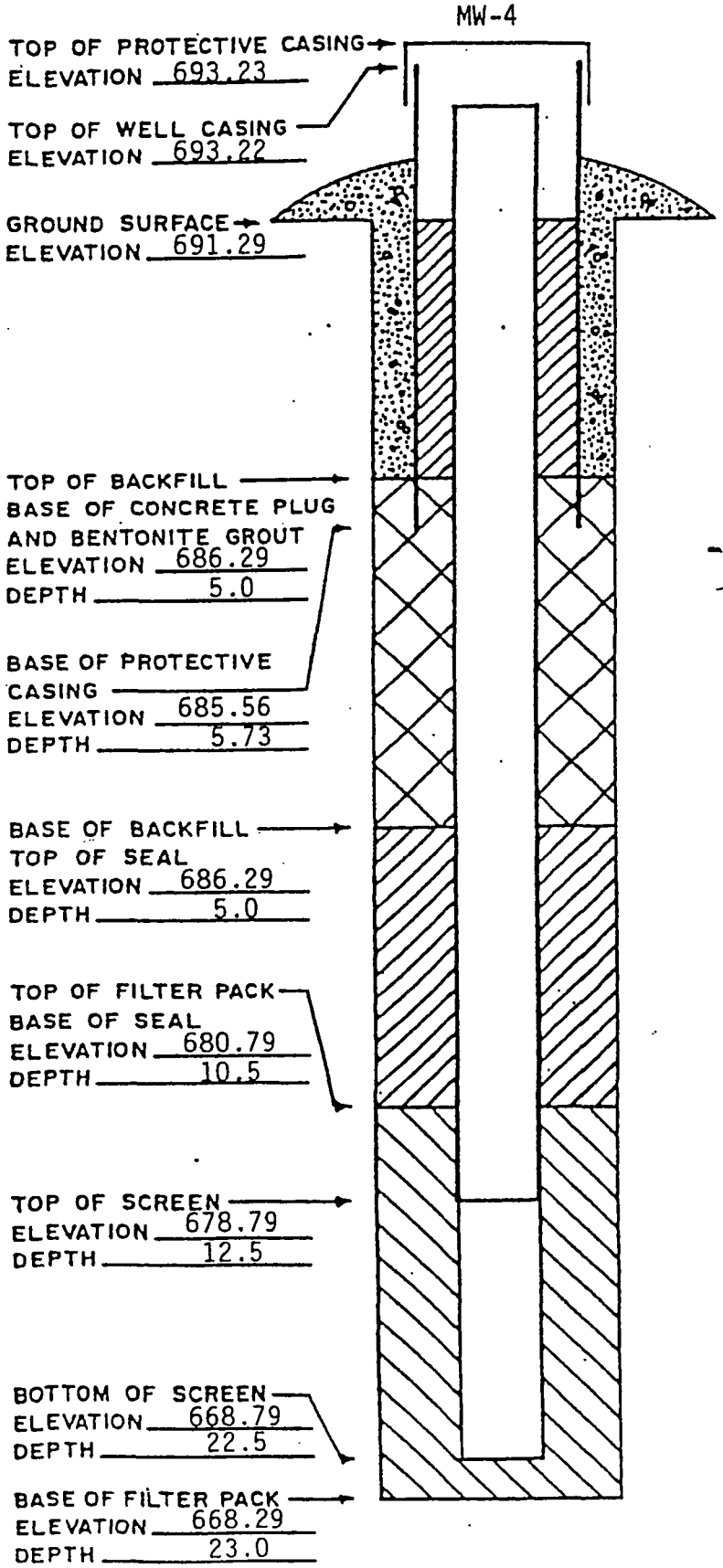
Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring well and piezometers.

Form #542-127

ELEVATIONS: ± 0.01 FT. MSL

DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTACH ENTIRE SOIL BORING LOG (SHOW SCREENL INTERVAL AND FILTER PACK INTERVAL



693.22
- 668.79
24.43

field boring log

Project: Muscatine C&D Landfill

Boring No. MW-4 Date Started 10-28-93 Date Complete 10-29-93

Drilled by Jay & Troy Logged by JAY Rig CME-57

subsurface stratigraphy

☐ 4" Flight Augers ☒ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
0	6.5	"Fill" Brick + Concrete Wood
	6.5	Steel "
6.5	12.0	LT Brown Sandy Clay
12.0		LT Brown & Fine-Med Sand

Bottom of Boring 23.0

water levels

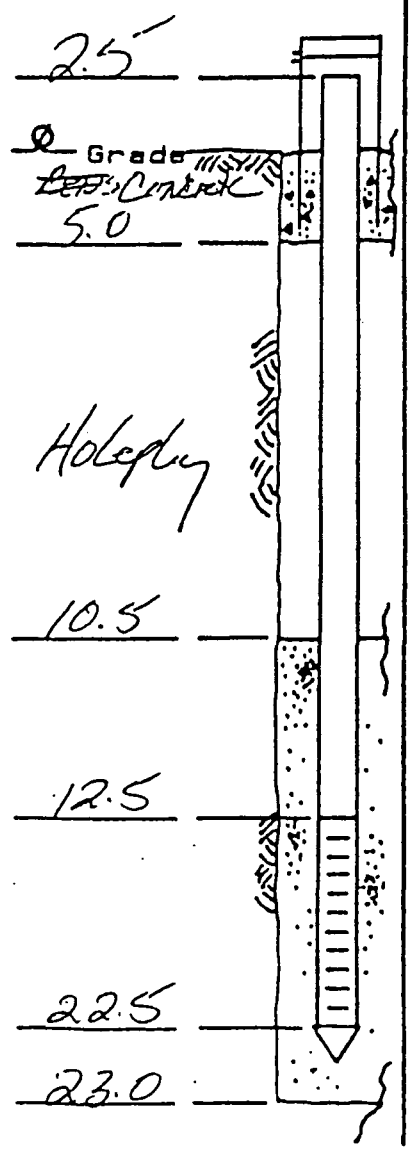
___ While Drilling

___ 0 Hours A.B.

14.5 14 Hr. A.B.

well details

☒ Stick-up Cover
☐ Flush Cover



sample data

Depth	Number/Type	Depth	Number/Type
~~10-15~~	~~1-CS~~		
~~15-20~~	~~2-CS~~		
~~9.5-14.5~~	~~1-CS~~		
~~14.5-19.5~~	~~2-CS~~		
~~19.5-23.0~~	~~3-CS~~		

CS = Continuous Sampler AS = Auger Sample

aquadrill

CaCO3	% RECOVERY	K (cm/sec)			MW-4	ELEVATION (ft, msl)	DEPTH (feet)	LITHOLOGY	MATERIALS DESCRIPTION
	0					686.0	5		0 to 6.5 WASTE Drillers report: "Fill", brick, concrete, wood, steel. "Fill" may refer to landfill cover, but no thickness was reported.
	0					681.0	10		6.5 to 23 EOLIAN SAND (Drillers report: Lt. Brown silty clay 6.5 to 9.5 feet, no sample). Very silty fine sand. Yellow brown. Leached. Light gray with orange mottles from 10 to 13 feet. Cohesive.
–	100					676.0	15		Not silty below 13.0 feet. Light brown to cream-colored.
–	54	1.5×10^{-3} Ball test				671.0	20		
–	32					666.0	25		Bottom of boring at 23.0 feet.
						661.0	30		
						656.0	35		
						651.0	40		
						646.0	45		
						641.0	50		

PROJECT Construction Rubble Landfill
PROJECT NUMBER 714520-J
SURFACE ELEVATION 691.29 Feet MSL
TOTAL DEPTH OF HOLE 23.0 Feet

LOG OF MW-4
LOCATION Muscatine, Iowa
GEOLOGIST Barbara Torney

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70 -SDP-4- 78 P
Well or Piezometer # MW-5 Date started 10/29/93 Date completed 11/2/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7433.6 N
Distance and direction from boundary to well 10488.8 E

Elevations (±0.01 ft. MSL):
Ground surface 714.70
* Top of protective casing 716.81
Top of well casing 716.80
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aguadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method Hollow stem auger
Drilling fluid None
Bore hole diameter 9"
Soil sampling method **
Depth of boring 75.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 71.10'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 5.0'
Depth of well 77.28'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 3.3 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite grout
Placement method Tremied
Volume 25.5 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing) 665.85 on 1/20/94
Stabilization time 3 months (?)
Well development method Pneumatic bailer, used until water is clear

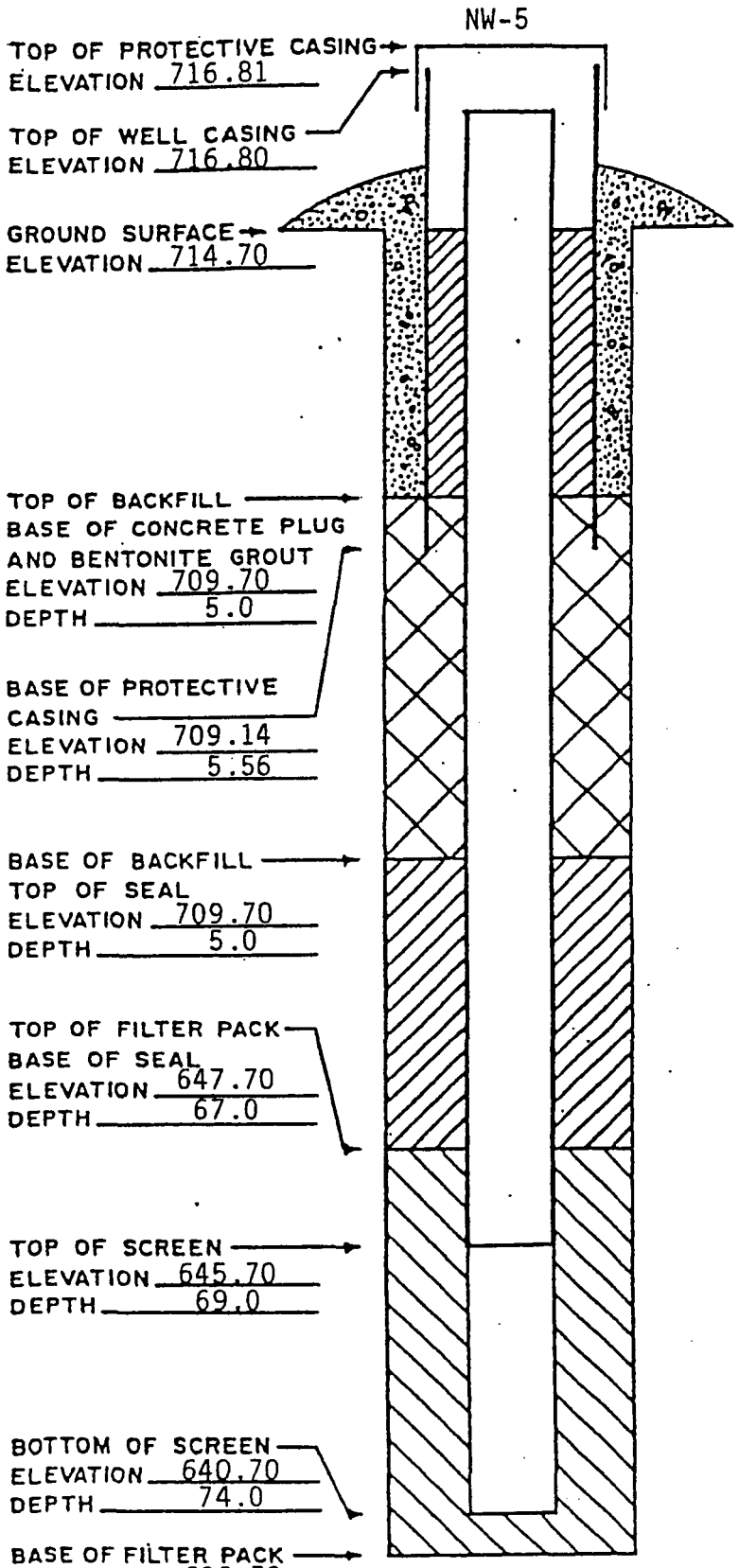
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Upgradient
Average depth of frostline 30"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring wells and piezometers.

Form #542-127

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTAC[H] ENTIRE SOIL BORING LOG
(SHOW SCREEN[I] INTERVAL AND FILTER PACK INTERVA[L]



field boring log

Project: Fiveash C+D Landfill

Boring No. MW-5 Date Started 10-29-93 Date Complete 11-2-93

Drilled by JAY + TROY Logged by JAY Rig CRV-5T

subsurface stratigraphy

11-20
37-47

☐ 4" Flight Augers ☑ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
0	4.0	DK BRN SCLAY
4.0	9.0	LT BRN SANDY SCLAY
9.0	31.0	LT BROWN FINE-MED SAND FSCT
31.0	39.0	OLIVE GREEN SCLAY TSAND GRAVEL
39.0	45.0	LT BROWN FINE-MED SAND
45.0		DK GREY SCLAY W/SAND + GRAVEL

Bottom of Boring 75.0

water levels

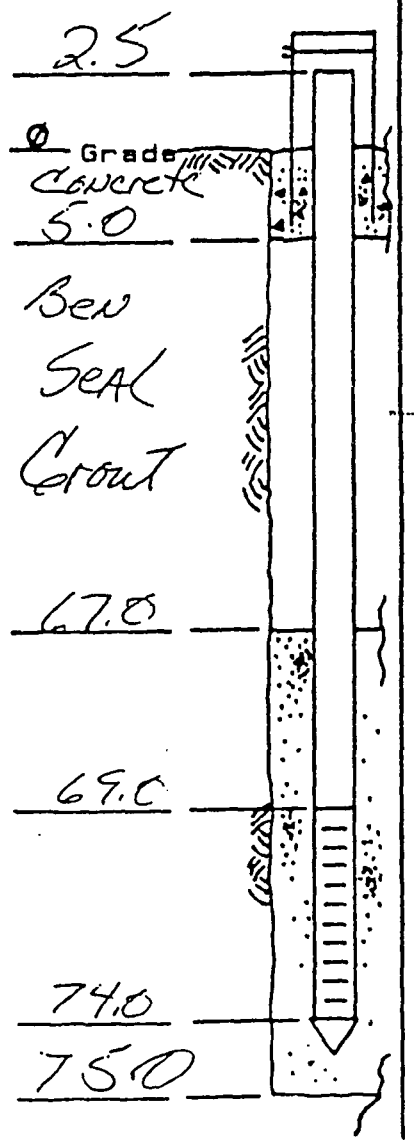
20.0 While Drilling

___ 0 Hours A.B.

130 72 Hr. A.B.

well details

☑ Stick-up Cover
☐ Flush Cover



sample data

Depth	Number/Type	Depth	Number/Type
0-5.0	1-CS	50-55	11-CS
5-10.0	2-CS	55-60	12-CS
10-15	3-CS	60-65	13-CS
15-20	4-CS	65-70	14-CS
20-25	5-CS	70-75	15-CS
25-30	6-CS		
30-35	7-CS		
35-40	8-CS		
40-45	9-CS		
45-50	10-CS		

CS = Continuous Sampler AS = Auger Sample

aquadrill

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70 -SDP-4- 78
Well or Piezometer # MW-6 Date started 11/3/93 Date completed 11/3/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7431.0 N
Distance and direction from boundary to well 10483.2 E

Elevations (±0.01 ft. MSL):
Ground surface 714.65
* Top of protective casing 716.74
Top of well casing 716.63
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method Hollow stem auger
Drilling fluid None
Bore hole diameter 9"
Soil sampling method **
Depth of boring 48.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 38.98'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 10.0'
Depth of well 48.95'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 5.3 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite grout
Placement method Tremied
Volume 12.3 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

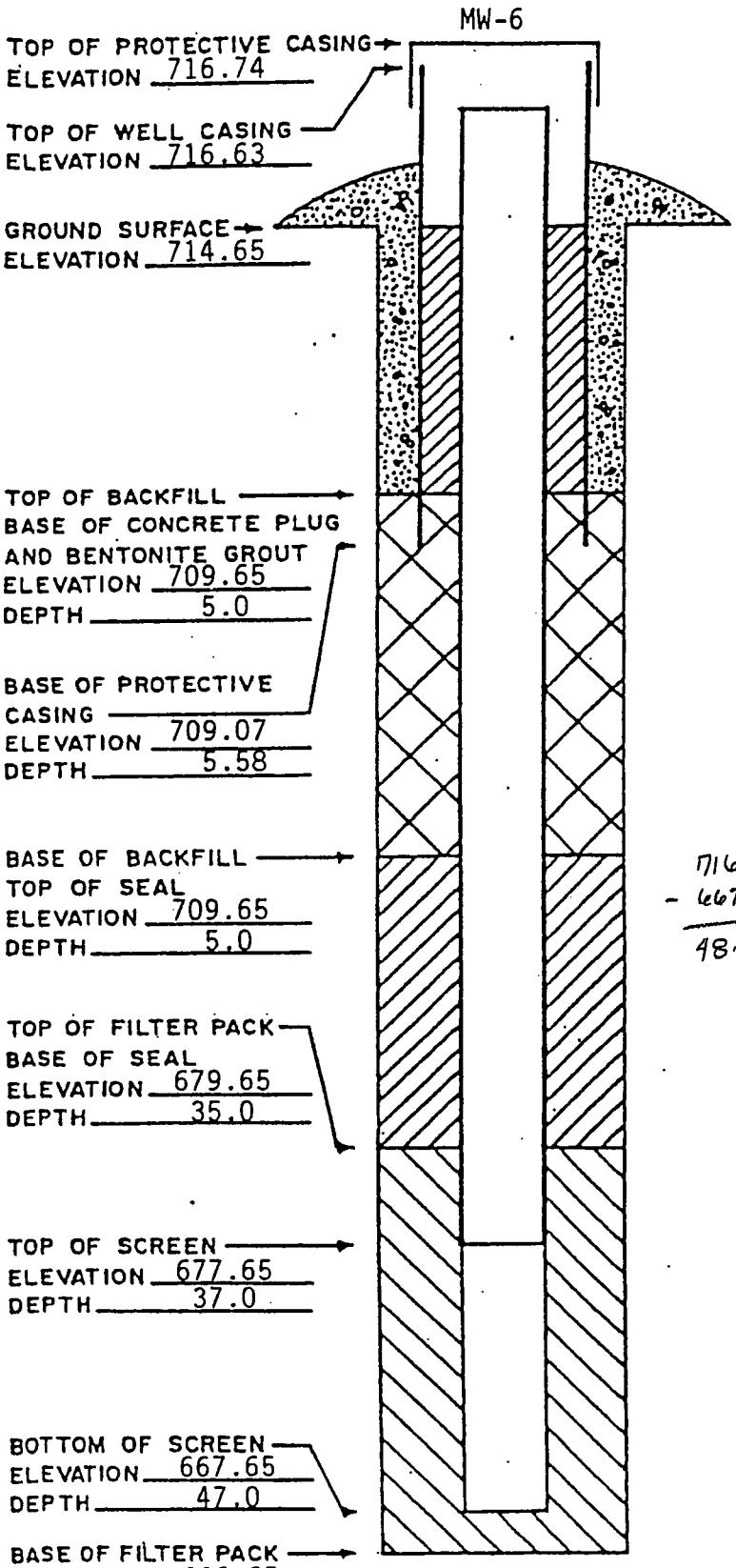
Water level (± 0.01 ft. below top of inner well casing) 674.88 on 1/20/94
Stabilization time 1 month (?)
Well development method Pneumatic bailer, used until water is clear
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Upgradient
Average depth of frostline 30"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring well and piezometers.

Form #542-127

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTAC'' ENTIRE SOIL BORING LOG
(SHOW SCREENL INTERVAL AND FILTER PACK INTERVAL



716.63
- 667.65
48.98

field boring log

Project: Muscatine C&D Landfill

Boring No. MW-6 Date Started 11-3-93 Date Complete 11-3-93

Drilled by Jay Logged by Jay Rig CME-57

subsurface stratigraphy

☐ 4" Flight Augers ☑ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
		See MW-5 for Soils Log
		Bottom of Boring 48.0

water levels

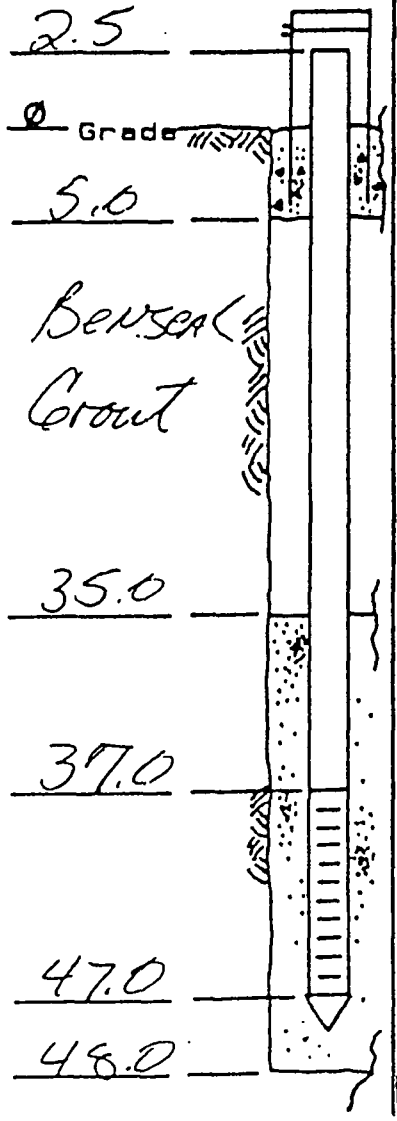
___ While Drilling

___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☑ Stick-up Cover
☐ Flush Cover



sample data

Depth	Number/Type	Depth	Number/Type
	100 / SAMPLING		

CS = Continuous Sampler AS = Auger Sample

aquadrill

MONITORING WELL / PIEZOMETER CONSTRUCTION
DOCUMENTATION FORM

Disposal site name City of Muscatine C & D Landfill Permit # 70 -SDP-4- 78
Well or Piezometer # MW-7 Date started 11/3/93 Date completed 11/3/93

A. Surveyed Locations and Elevations

Locations (± 0.5 ft.):
Specify corner of site Survey grid
Distance and direction along boundary 7428.0 N
Distance and direction from boundary to well 10477.4 E

Elevations (±0.01 ft. MSL):
Ground surface 714.40
* Top of protective casing 716.64
Top of well casing 716.65
Benchmark elevation 723.29
Benchmark description Arrowhead bolt at hydrant at Newell & Kindler Sts.
*Measured at hinge line

B. Soil Boring Information

Name and address of construction company Aquadrill, Inc.
R.R. 2, Box 18
Iowa City, IA 52240
Name of driller Jeff Joslyn
Drilling method Hollow stem auger
Drilling fluid None
Bore hole diameter 9"
Soil sampling method **
Depth of boring 21.0'
** Laskey continuous sampler

C. Monitoring Well Installation

Casing material Schedule 40 PVC
Length of casing 12.25'
Outside casing diameter 2.375"
Inside casing diameter 2.0"
Casing joint type Flush threaded
Casing/screen joint type Flush threaded
Screen material Schedule 40 PVC
Screen opening size 0.010" = 0.25 mm
Screen length 10.0'
Depth of well 22.55'

Well Installation, continued:

Filter pack:
Material Muscatine #0-C sand
Grain size Effective size = 0.930 mm
Volume 5.3 c.f.
Seal (minimum 3 ft. length above filter pack):
Material Bentonite granules
Placement method Poured
Volume 1.2 c.f.

Backfill (if different from seal):
Material Same as seal
Placement Method
Volume

Surface seal design:
Material of protective casing:
4" square steel set in concrete
Material of grout between protective casing and well casing:
Bentonite
Protective cap:
Material Steel (not airtight)
Vented? Y/N Locking? Y/N Y
Well cap:
Material PVC expandable, not
Vented? Y/N tightened

D. Groundwater Measurement

Water level (± 0.01 ft. below top of inner well casing) 698.15 on 1/20/9
Stabilization time <1 day
Well development method Pneumatic bailer, used until water is clear

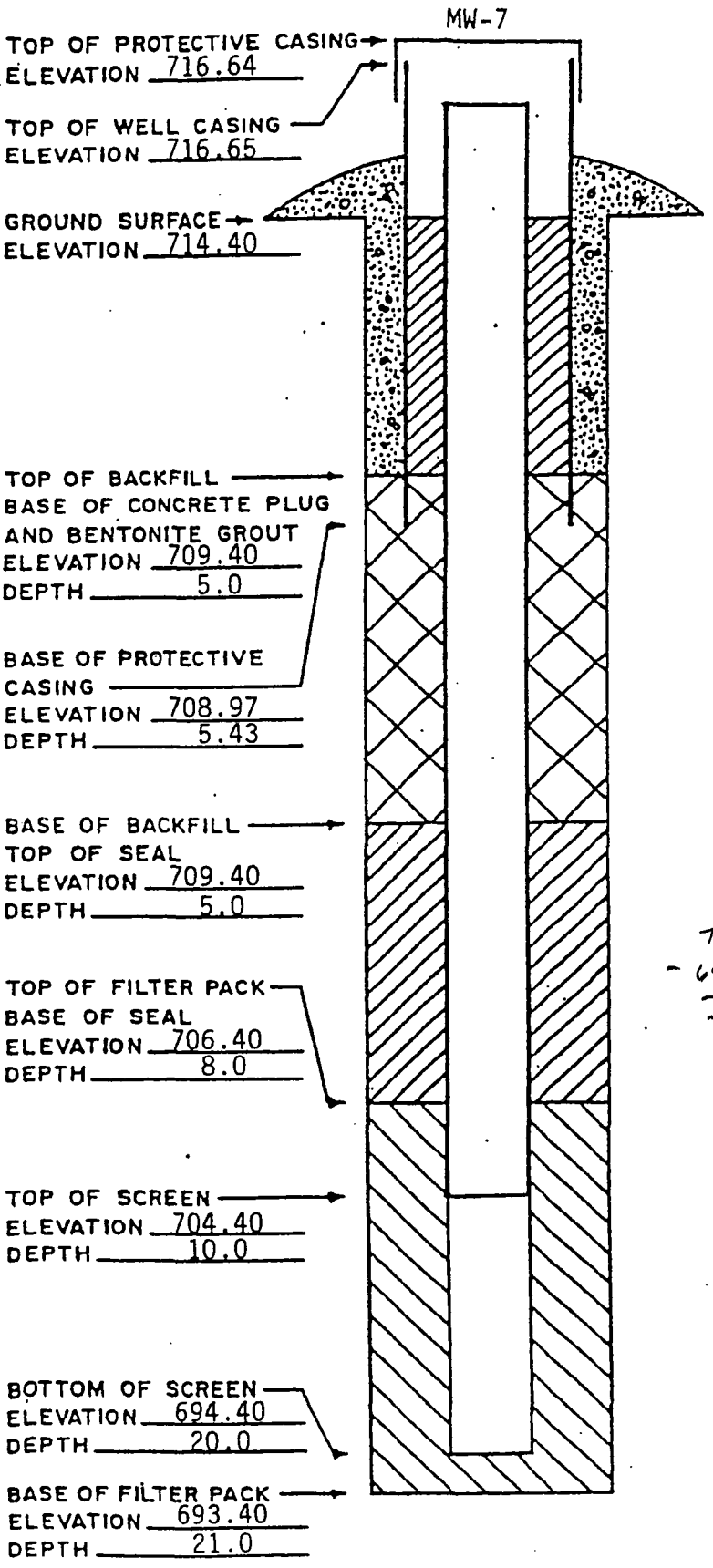
Upgradient or downgradient well? (see piezometric map from Hydrogeologic study) Upgradient
Average depth of frostline 30"

Attachments: Driller's log. Pipe schedules and grouting schedules. 8 1/2 inch X 11 inch map showing location of all monitoring well and piezometers.

Form #542-127

ELEVATIONS: ± 0.01 FT. MSL
DEPTHS: ± 0.1 FT. FROM GROUND SERFACE

SPACE TO ATTA' ENTIRE SOIL BORING LOG
(SHOW SCREENE INTERVAL AND FILTER PACK INTERVA



716.65
- 694.40
22.25 bottom depth

field boring log

Project Muscatine C&D Landfill

Boring No. MW-7 Date Started 11-3-93 Date Complete 11-3-93

Drilled by Jay + Tom Logged by Jay Rig CRU-57

subsurface stratigraphy

☐ 4" Flight Augers ☑ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
		See MW-5 for Soils Log
		Bottom of Boring 21.0

water levels

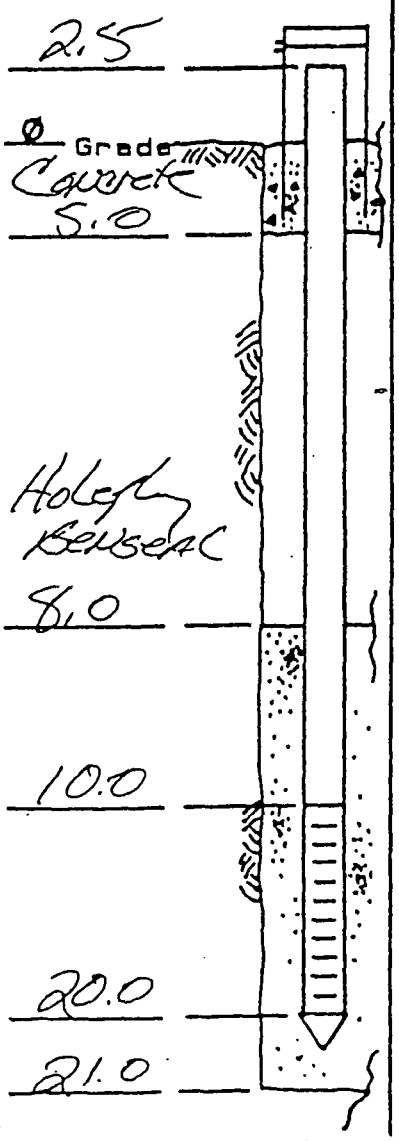
___ While Drilling

___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☑ Stick-up Cover
☐ Flush Cover

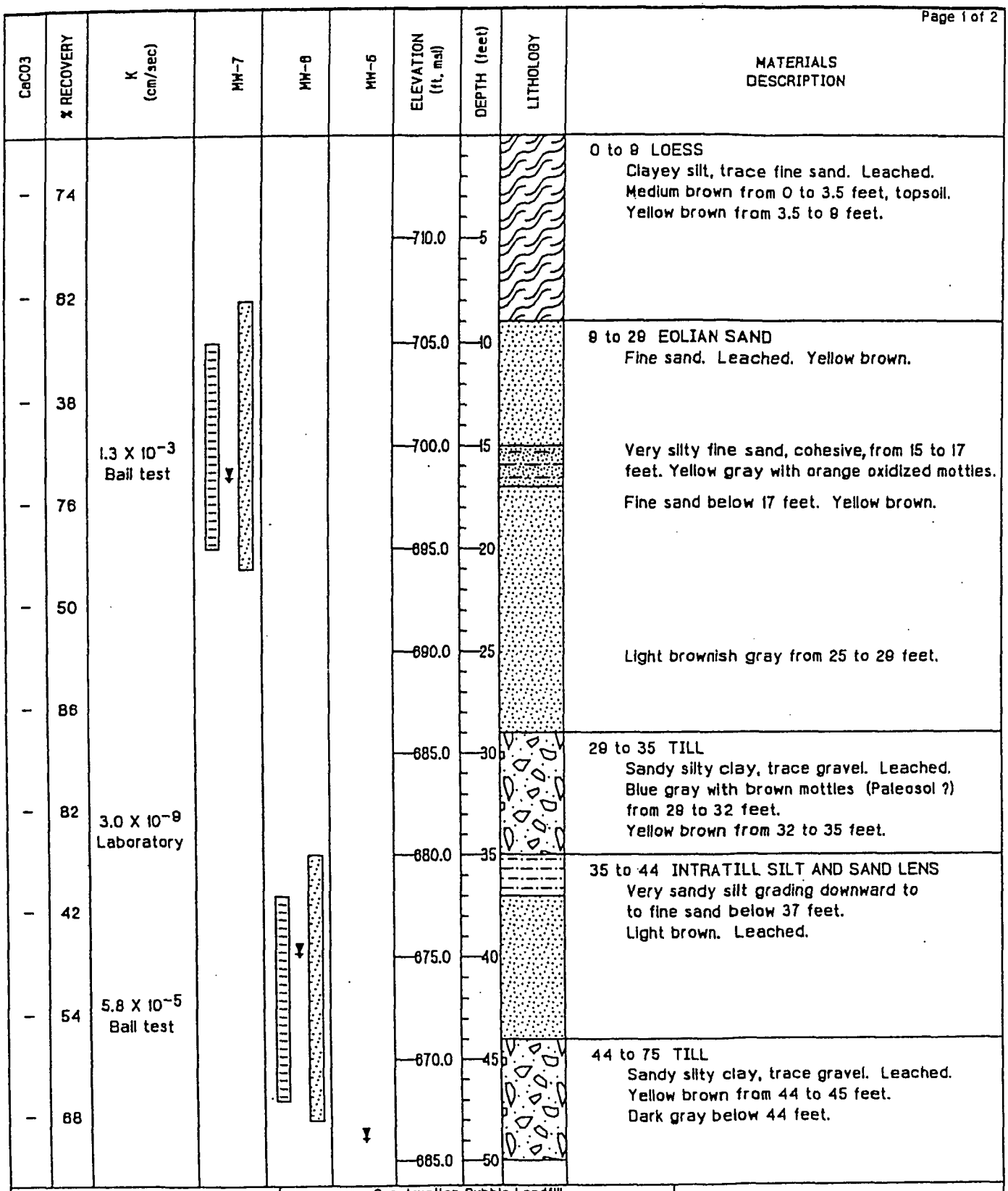


sample data

Depth	Number/Type	Depth	Number/Type
	No Sampling		

CS = Continuous Sampler AS = Auger Sample

aquadrill



PROJECT Construction Rubble Landfill

PROJECT NUMBER 714520-J

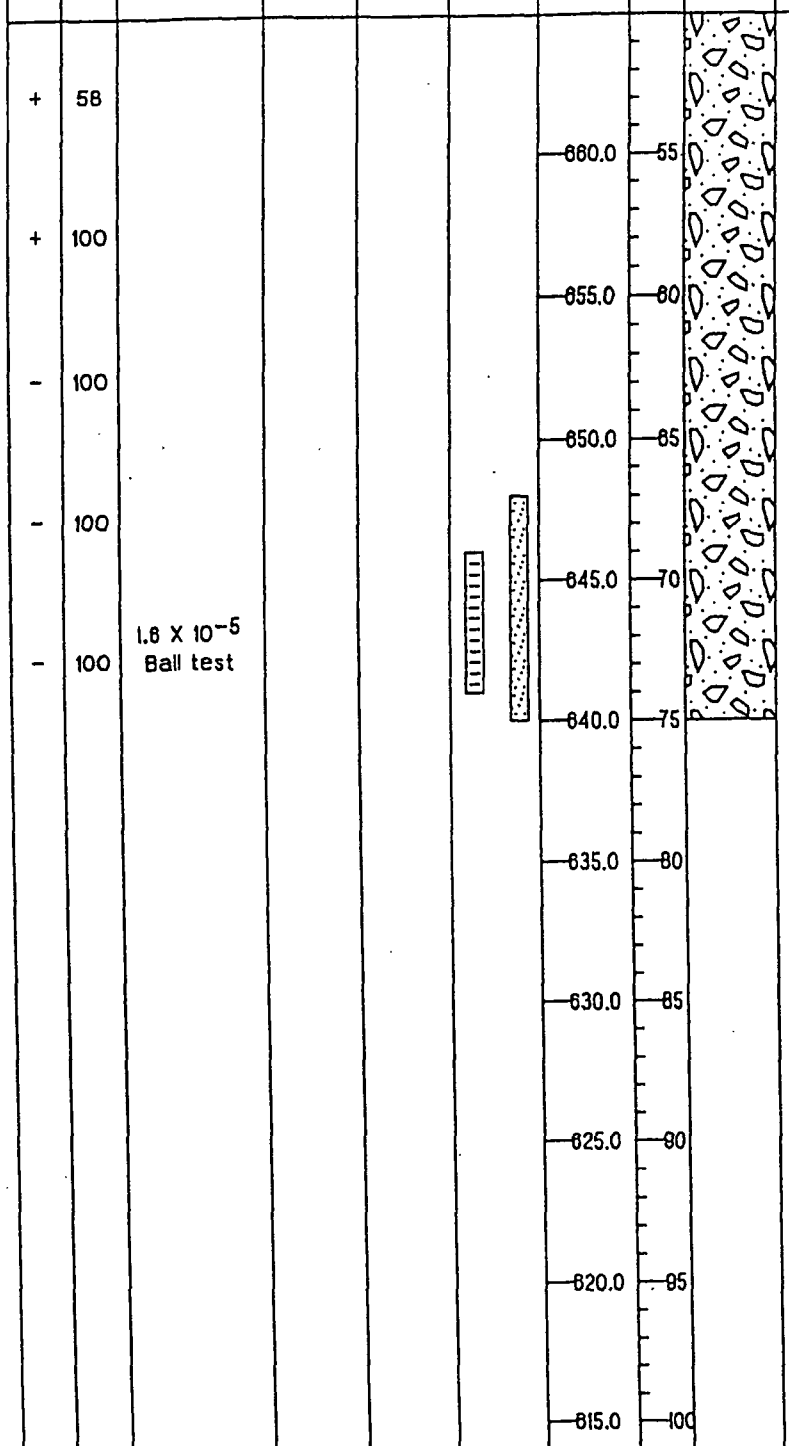
SURFACE ELEVATION 714.70 Feet MSL

TOTAL DEPTH OF HOLE 75.0 Feet

LOG OF MW-5, MW-6, MW-7

LOCATION Muscatine, Iowa

GEOLOGIST Barbara Torney



MATERIALS DESCRIPTION

Unleached from 50 to 60 feet.

Leached from 60 to 75 feet.

Bottom of borehole at 75.0 feet.

PROJECT Construction Rubble Landfill

PROJECT NUMBER 714520-J

SURFACE ELEVATION 714.70 Feet MSL

TOTAL DEPTH OF HOLE 75.0 Feet

LOG OF MW-5, MW-6, MW-7

LOCATION Muscatine, Iowa

GEOLOGIST Barbara Torney

field boring log

Project: Muscatine C&D Landfill

Boring No. LBZ-8 Date Started 11-2-93 Date Complete 11-3-93

Drilled by Troy Jay Logged by Jay Rig ORU-57

subsurface stratigraphy

☐ 4" Flight Augers ☑ 4¼" ID H.S. ☐ 6¼" ID H.S.

From	To	Description
0	2.5±	DK Brn Sdy Clay w/Gravel "Fill"
2.5		"Fill" Concrete Slabs Brick
	41.5	"Soil" Sand
		10-Bag Gravel Back
		6-Bags Holeplug
		Air drilling w/ 4½" Button Bit
Bottom of Boring		46.0

water levels

39.0 While Drilling

___ 0 Hours A.B.

___ ___ Hr. A.B.

well details

☐ Stick-up Cover

☐ Flush Cover

Top of Cover 5.0

Ø Grade

Holeplug 21.5

30.5

40.5

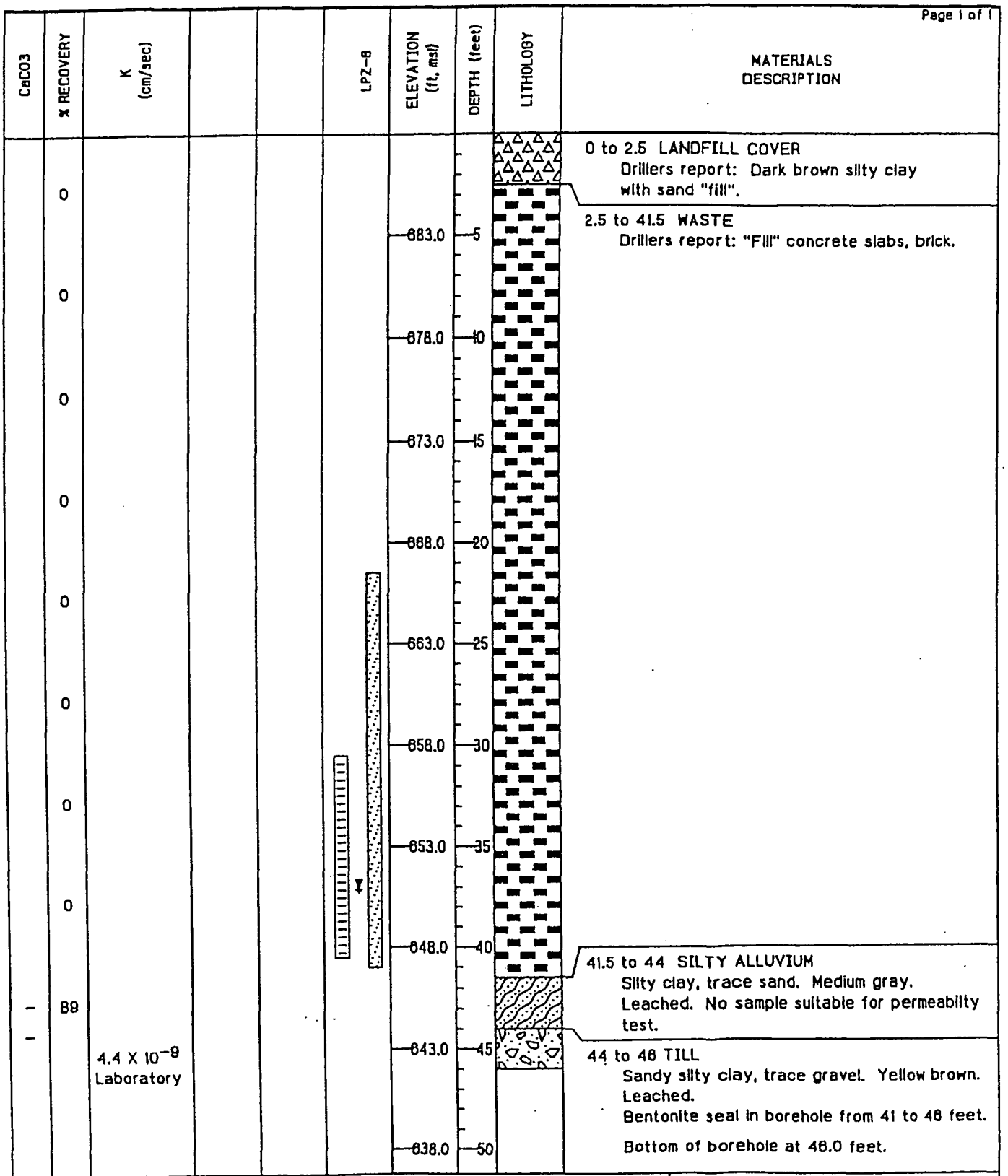
41.0 Holeplug 46.0

sample data

Depth	Number/Type	Depth	Number/Type
41.5-46.0	1-CS		

CS = Continuous Sampler AS = Auger Sample

Aquadrill



PROJECT Construction Rubble Landfill

PROJECT NUMBER 714520-J

SURFACE ELEVATION 687.85 Feet MSL

TOTAL DEPTH OF HOLE 46.0 Feet

LOG OF LPZ-8

LOCATION Muscatine, Iowa

GEOLOGIST Barbara Torney

APPENDIX F

HYDRAULIC CONDUCTIVITIES

H. R. GREEN LAB TESTING
CONSTRUCTION - DEMOLITION LANDFILL
TERRACON JOB NO. 06941003
H.R. GREEN JOB NO. 714520

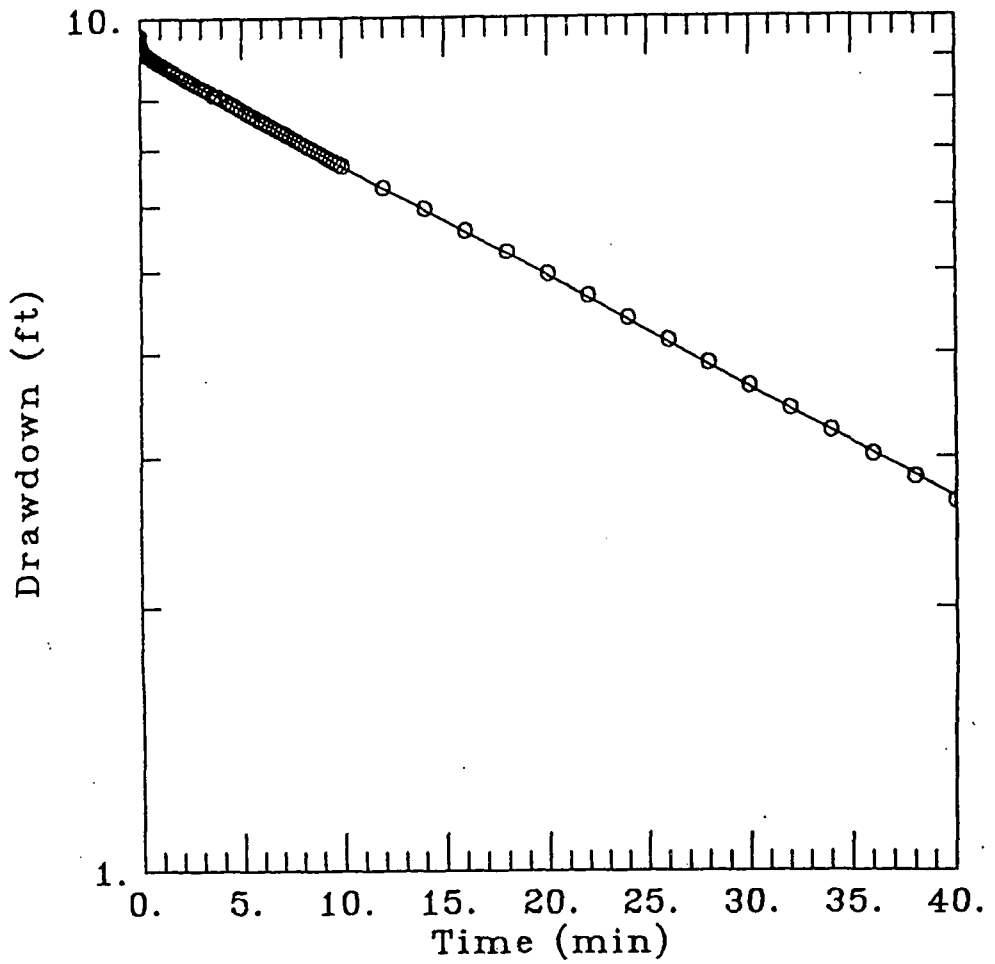
Sample No.	Sample Description	Dry Density	Moisture Content	Coefficient of Permeability cm/sec.
LPZ-8 45 - 46'	Brown Gray Sandy Lean to Fat Clay, Trace Gravel	115.2	17.9	4.4×10^{-9}
MW-1 62 - 63'	Gray Sandy Lean Clay, Trace Gravel	131.0	8.3	1.8×10^{-8}
MW-5 33- 34'	Gray Brown Sandy Lean to Fat Clay	103.7	22.5	3.0×10^{-9}

Note: The permeability tests were performed in a fluid filled chamber with the sample surrounded by a flexible membrane. Back pressure was used to aid in saturating the sample, and a water head of 5 psi was used for percolation.

Terracon

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-1



DATA SET:
2MW1.ADT
02/10/94

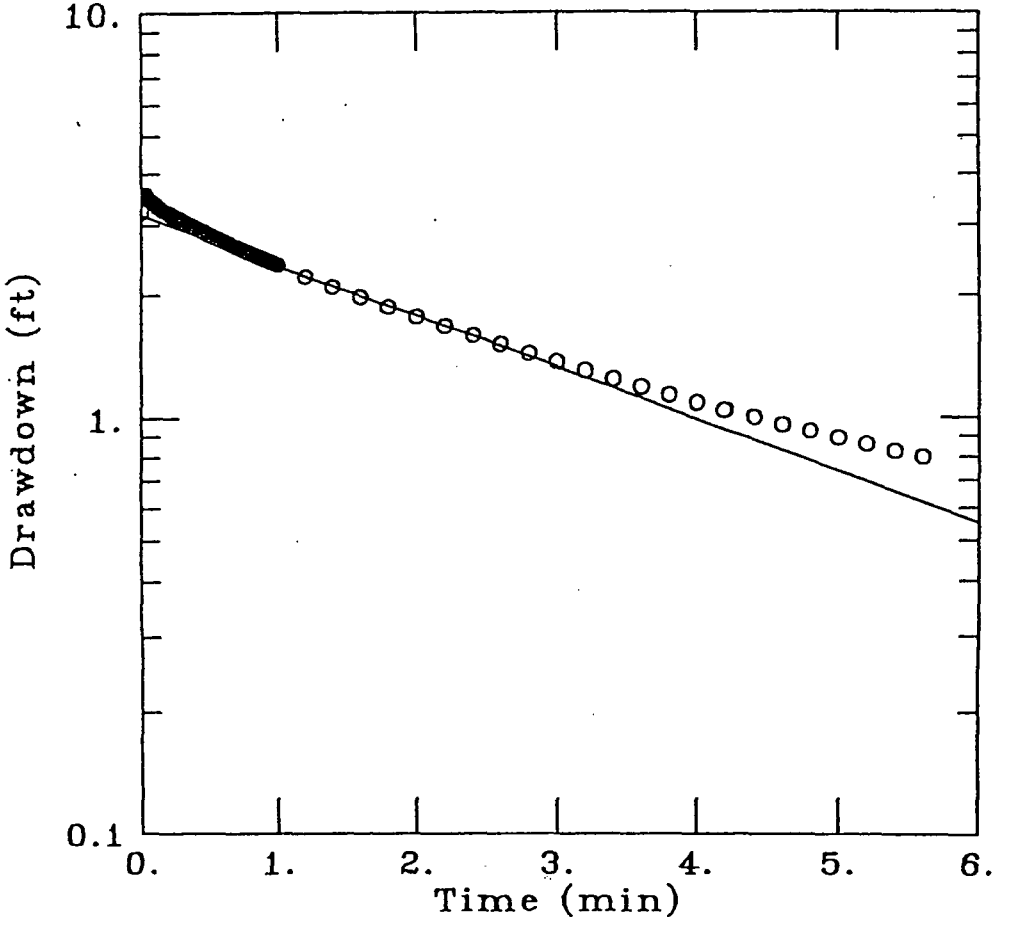
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-1
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 4.0303E-05 ft/min
y0 = 9.075 ft

TEST DATA:
H0 = 10.83 ft
rc = 0.083 ft
rw = 0.375 ft
L = 9. ft
b = 62.75 ft
H = 62.75 ft

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-2



DATA SET:
2mw2.adt
02/10/94

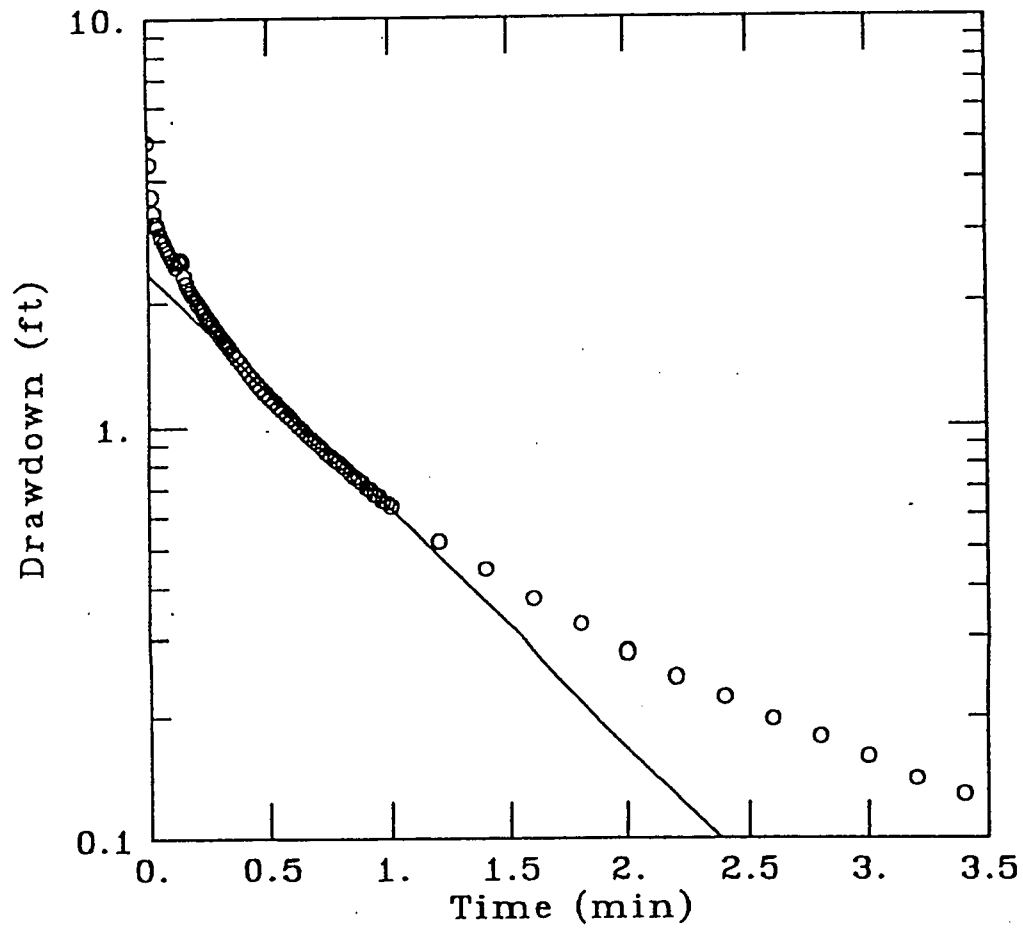
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-2
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 0.0003232 ft/min
y0 = 3.18 ft

TEST DATA:
H0 = 3.224 ft
rc = 0.083 ft
rw = 0.375 ft
L = 10. ft
b = 35.76 ft
H = 35.76 ft

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-3



DATA SET:
mw3.adt
02/10/94

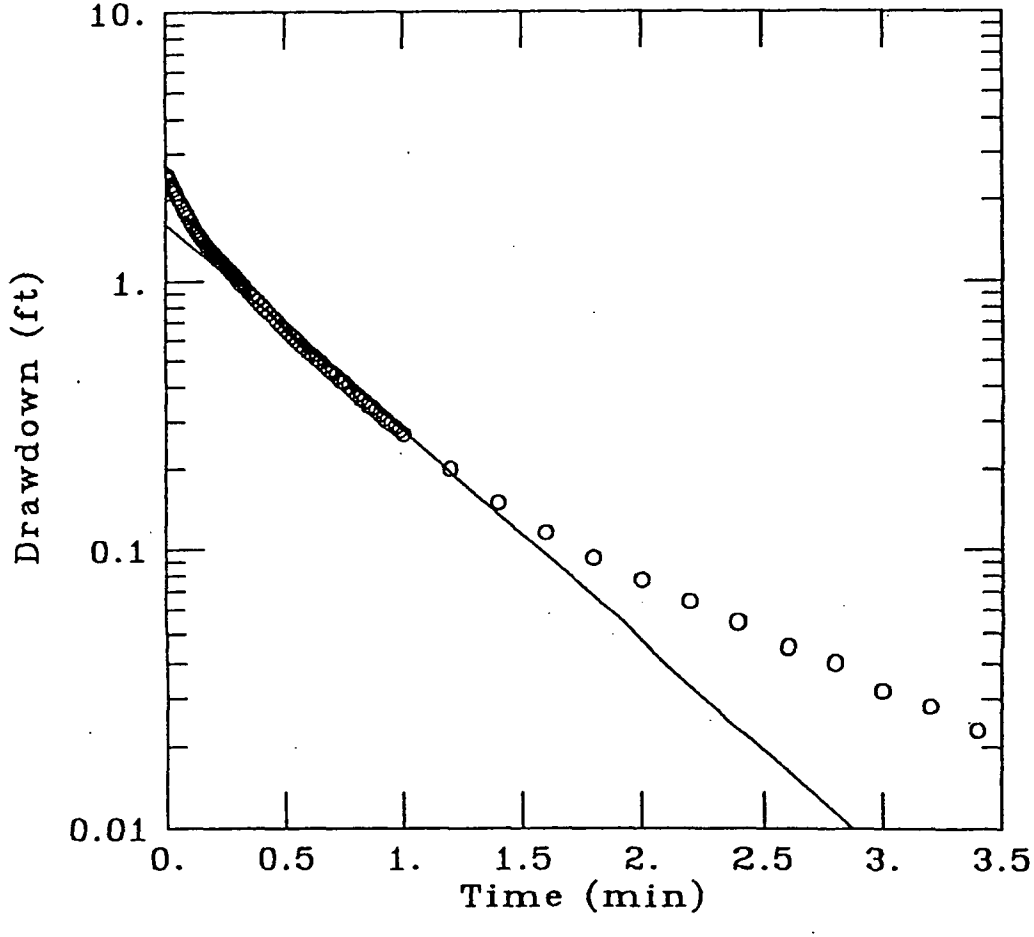
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-3
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 0.007299 ft/min
y0 = 2.358 ft

TEST DATA:
H0 = 4.926 ft
rc = 0.221 ft
rw = 0.375 ft
L = 12. ft
b = 13.6 ft
H = 13.6 ft

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-4



DATA SET:
mw4.adt
02/10/94

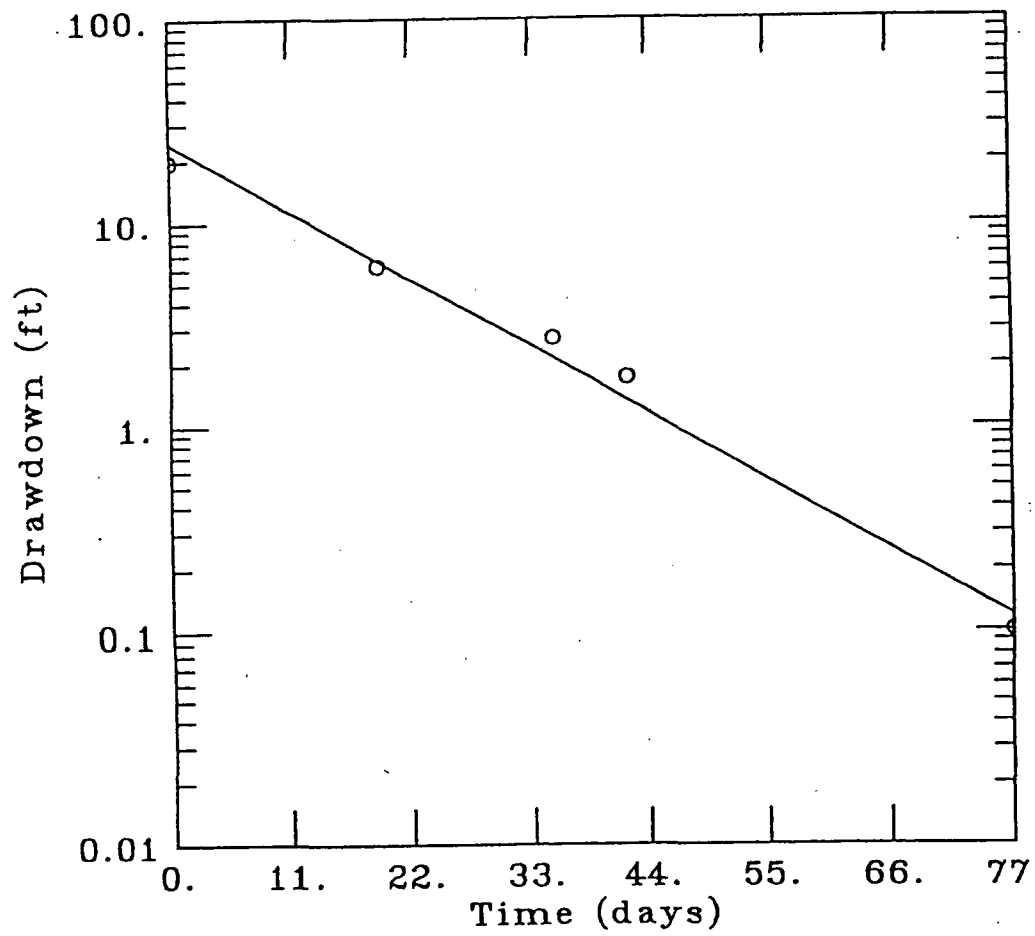
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-4
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 0.003012 ft/min
y0 = 1.632 ft

TEST DATA:
H0 = 2.514 ft
rc = 0.083 ft
rw = 0.083 ft
L = 6.88 ft
b = 6.88 ft
H = 6.88 ft

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-5



DATA SET:
5TIME2.ADT
02/24/94

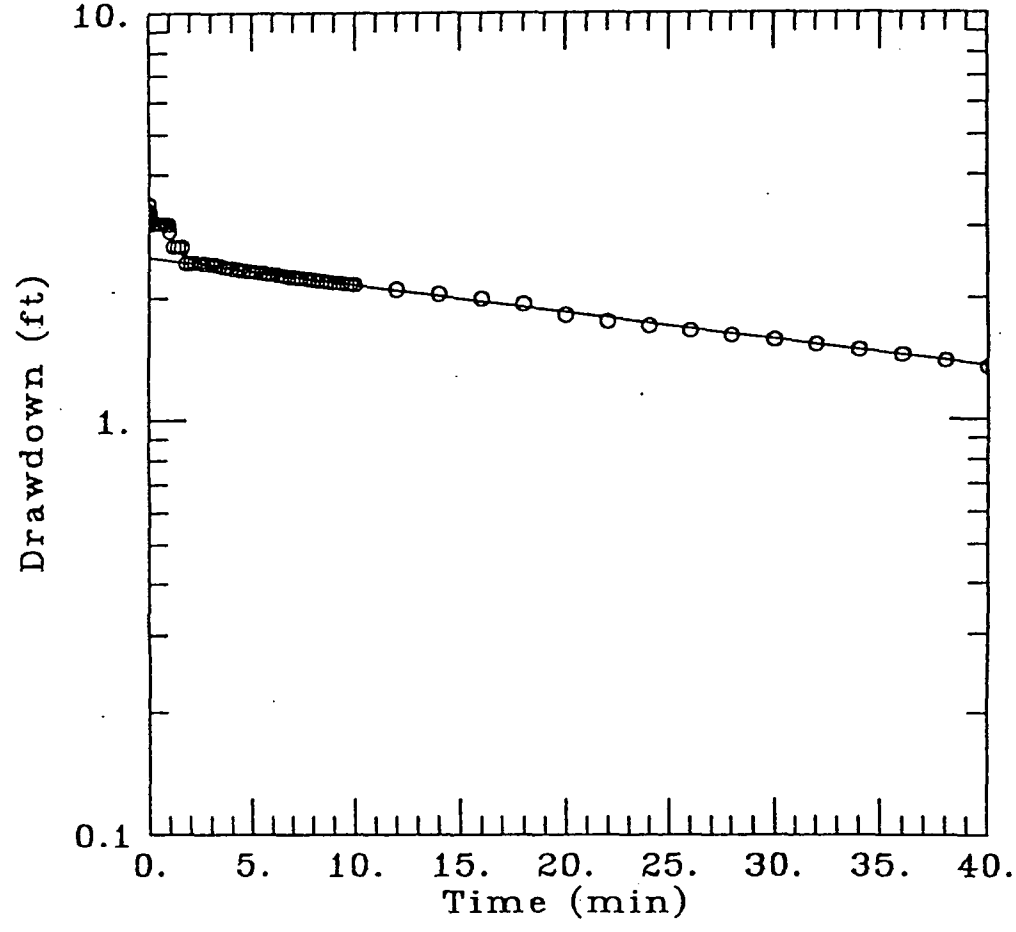
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-5
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 8.7934E-05 ft/day
y0 = 24.35 ft

TEST DATA:
H0 = 19.8 ft
rc = 0.083 ft
rw = 0.375 ft
L = 8. ft
b = 26. ft
H = 26. ft

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-6



DATA SET:
3MW6.ADT
02/10/94

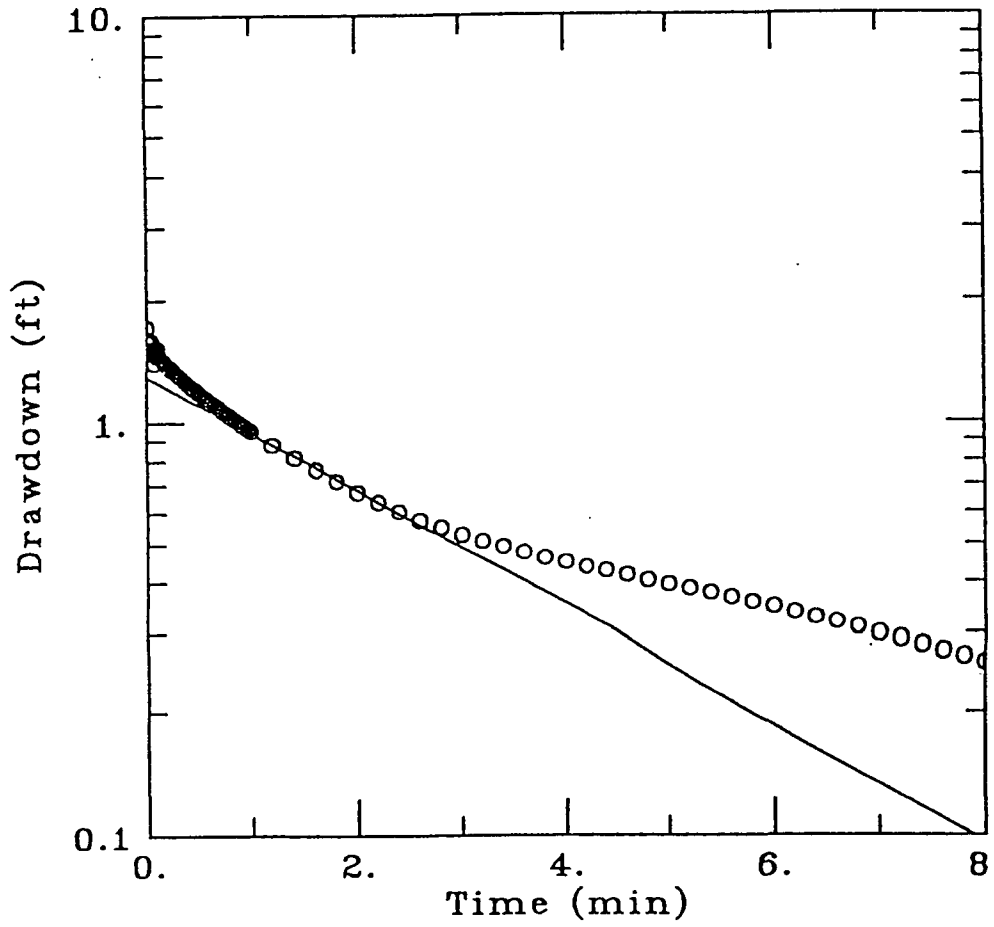
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-6
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 0.0001149 ft/min
y0 = 2.523 ft

TEST DATA:
H0 = 3.383 ft
rc = 0.221 ft
rw = 0.375 ft
L = 7.23 ft
b = 7.23 ft
H = 7.23 ft

GREEN ENVIRONMENTAL SERVICES	Client: CONSTRUCTION RUBBLE LANDFILL
Project No.: 714520-J	Location: MUSCATINE, IOWA

MW-7



DATA SET:
mw7.adt
02/10/94

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
JANUARY 20, 1994
TEST WELL:
MW-7
OBS. WELL:
NA

ESTIMATED PARAMETERS:
K = 0.002545 ft/min
y0 = 1.301 ft

TEST DATA:
H0 = 1.722 ft
rc = 0.221 ft
rw = 0.375 ft
L = 4.75 ft
b = 12.75 ft
H = 4.75 ft

ATTACHMENT C

Analytical Results & Summary Tables

CITY OF MUSCATINE C&D LANDFILL
70-SDP-4-78C
MONITORING WELL SAMPLING RESULTS

SAMPLING DATE: 03/06/2007

PARAMETER	MCL	D.G.W MW 2	D.G.W MW 3	D.G.W MW 4	U.G.W MW 6	U.G.W MW 7
ug/L						
Benzene *	5	NT	NT	NT	NT	NT
Carbon tetrachloride *	5	NT	NT	NT	NT	NT
1,4-Dichlorobenzene *	0.6	NT	NT	NT	NT	NT
1,2-Dichloroethane *	5	NT	NT	NT	NT	NT
1,1-Dichloroethylene *	7	NT	NT	NT	NT	NT
1,1,1-Trichloroethane *	200	NT	NT	NT	NT	NT
Vinyl Chloride	2	NT	NT	NT	NT	NT
cis-1,2-Dichloroethylene	70	NT	NT	NT	NT	NT
Tetrachloroethylene *	5	NT	NT	NT	NT	NT
Trichloroethylene *	5	NT	NT	NT	NT	NT
mg/L						
Arsenic, dissolved	0.05	NT	NT	NT	NT	NT
Barium, dissolved	2	NT	NT	NT	NT	NT
Cadmium, dissolved	0.005	NT	NT	NT	NT	NT
Chromium, dissolved	0.1	NT	NT	NT	NT	NT
Copper, dissolved	1.3	NT	NT	NT	NT	NT
Zinc, dissolved	5	NT	NT	NT	NT	NT
Lead, dissolved	0.015	NT	NT	NT	NT	NT
Mercury, dissolved	0.002	NT	NT	NT	NT	NT
Magnisium, dissolved	---	NT	NT	NT	NT	NT
Iron, dissolved	0.3	0.460	2.85	0.966	0.194	DRY
Chloride	250	<10	64	52	62	DRY
Nitrogen, Ammonia	---	1.2	1.7	<1.0	<1.0	DRY
Chemical Oxygen Dema	---	<10	27	20	<10	DRY
Phenols	---	NT	NT	NT	NT	NT
TOX	---	NT	NT	NT	NT	NT
pH	6.5-8.5	7.3	7.3	7.2	7.5	DRY
Temperature, celsius	---	10	10	14	13	DRY
Conductivity	---	592	1520	751	812	DRY

Keystone
LABORATORIES, INC.

RECEIVED MAR 16 2007

ACCREDITED IN ACCORDANCE WITH nelac
MEMBER ACIL

Accreditations:
Iowa DNR: 095
New Jersey DEP: IA001
Kansas DHE: E-10287

ANALYTICAL REPORT

March 14, 2007

Work Order: 17C0276

Report To	Work Order Information
Todd Whipple Fox Engineering Associates, Inc. 1601 Golden Aspen Drive, Suite 103 Ames, IA 50010	Date Received: 03/07/2007 3:37PM Collector: Richard Freeman Phone: 515-233-0000 PO Number:

Project: Muscatine Sanitary Landfill-Spring < & D
Project Number: 6008-06A

Analyte	Result	MRL	Method	Analyst	Analyzed	Qualifier
17C0276-01 MW2			Matrix:Water		Collected: 03/06/07 17:00	
Determination of Conventional Chemistry Parameters						
Chemical Oxygen Demand	<10 mg/l	10	EPA 410.4	SAA	03/09/07 14:42	
Chloride	<10 mg/l	10	EPA 9252	WAS	03/09/07 11:26	
Nitrogen, Ammonia	**1.2 mg/l**	**1.0**	SM 4500-NH3 F	SAA	03/08/07 14:44	
Determination of Dissolved Metals						
Iron, dissolved	**0.460 mg/l**	**0.030**	EPA 6010B	LAR	03/12/07 11:43	
17C0276-02 MW3			Matrix:Water		Collected: 03/06/07 17:15	
Determination of Conventional Chemistry Parameters						
Chemical Oxygen Demand	**27 mg/l**	**10**	EPA 410.4	SAA	03/09/07 14:42	
Chloride	**64 mg/l**	**10**	EPA 9252	WAS	03/09/07 11:26	
Nitrogen, Ammonia	**1.7 mg/l**	**1.0**	SM 4500-NH3 F	SAA	03/08/07 14:44	
Determination of Dissolved Metals						
Iron, dissolved	**2.85 mg/l**	**0.030**	EPA 6010B	LAR	03/12/07 11:47	
17C0276-03 MW4			Matrix:Water		Collected: 03/06/07 17:45	
Determination of Conventional Chemistry Parameters						
Chemical Oxygen Demand	**20 mg/l**	**10**	EPA 410.4	SAA	03/09/07 14:42	
Chloride	**52 mg/l**	**10**	EPA 9252	WAS	03/09/07 11:26	
Nitrogen, Ammonia	<1.0 mg/l	1.0	SM 4500-NH3 F	SAA	03/08/07 14:44	
Determination of Dissolved Metals						
Iron, dissolved	**0.966 mg/l**	**0.030**	EPA 6010B	LAR	03/12/07 11:51	
17C0276-04 MW6			Matrix:Water		Collected: 03/06/07 18:10	
Determination of Conventional Chemistry Parameters						
Chemical Oxygen Demand	<10 mg/l	10	EPA 410.4	SAA	03/09/07 14:42	
Chloride	**62 mg/l**	**10**	EPA 9252	WAS	03/09/07 11:26	
Nitrogen, Ammonia	<1.0 mg/l	1.0	SM 4500-NH3 F	SAA	03/08/07 14:44	
Determination of Dissolved Metals						
Iron, dissolved	**0.194 mg/l**	**0.030**	EPA 6010B	LAR	03/12/07 11:56	

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17C0276

17C0276-04	MW6	Matrix:Water	Collected: 03/06/07 18:10

End of Report

Sue Thompson

Keystone Laboratories, Inc.
Sue Thompson For Jeffrey King, Ph.D.
Laboratory Director

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

CHAIN OF CUSTODY RECORD

Keystone LABORATORIES, INC.

☐ 600 E. 17th St. S.
Newton, IA 50208
Phone: 641-792-8451
Fax: 641-792-7989

☐ 3012 Ansborough Ave.
Waterloo, IA 50701
Phone: 319-235-4440
Fax: 319-235-2480
www.keystonelabs.com

☐ 1155 Adams, Suite 120
Kansas City, KS 66103
Phone: 913-321-7856
Fax: 913-321-7937

PRINT OR TYPE INFORMATION BELOW

SAMPLER: Richard Freeman
SITE NAME: Muscatine C&D
ADDRESS:
CITY/ST/ZIP:
PHONE:

REPORT TO:
NAME: Todd Whipple
COMPANY NAME: Fox
ADDRESS:
CITY/ST/ZIP:
PHONE:
FAX:

BILL TO:
NAME: Laurne Payne
COMPANY NAME: Muscatine Recycling
ADDRESS:
CITY/ST/ZIP: Muscatine
PHONE:

Keystone Quote No.: (If Applicable)

CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	ANALYSES REQUIRED	LAB USE ONLY: LABORATORY SAMPLE NUMBER
mw2	3/6/07	500PM	Monitoring Well 2	3	W	X	X	01
mw3	"	515PM	"	3	"	"	"	02
mw4	"	545PM	"	4	"	"	"	03
mw6	"	610PM	"	6	"	"	"	04

LABORATORY WORK ORDER NO.: 17C0276

SAMPLE TEMPERATURE UPON RECEIPT: °C

SAMPLE CONDITION/COMMENTS:

Relinquished by: (Signature) Richard Freeman	Date 3/7/07 Time 330PM	Received by: (Signature)	Date Time	Turn-Around: ☑ Standard ☐ Rush ____ Contact Lab Prior to Submission	
Relinquished by: (Signature)	Date Time	Received for Lab by: (Signature) Denise Henning	Date 3-7-07 Time 3:37 PM	Remarks:	

Original - Return with Report • Yellow - Lab Copy • Pink - Sampler Copy

FORM: CCR 7-97

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY of MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-2 Upgradient ____
Downgradient ✓

Name of person sampling ____

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? Yes Standing Water or Litter? No
If no, explain ____ If yes, explain ____

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 640.86 Ground Elevation 638.70
Depth of Well 42.16 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	3/6/07	8.0	
*After Purging		26.0	
*Before Sampling	3/6/07 5:00pm	8.5	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 10
No.of Well Volumes (based on current water level) 2
Was well pumped/bailed dry? No

Equipment used:
Bailer type Disposable 'Dedicated Bailer ____
Pump type ____ 'Dedicated Bailer ____
If not dedicated, method of cleaning ____

D.) FIELD MEASUREMENT

Weather Conditions cloudy 35°
Field Measurments (after stabilization):
Temperature 10 Units ____
Equipment Used HACH COMPANY POCKET PAL
pH 7.3
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 592 Units ____
Equipment Used HACH COMPANY POCKET PAL

Comments ____

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

542-1322

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY OF MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-3 Upgradient ____
Downgradient ✓

Name of person sampling RMF

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? Yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 640.36 Ground Elevation 638.30
Depth of Well 22.06 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	3/6/07	8.1	
*After Purging		17.5	
*Before Sampling	3/6/07 5:15pm	8.1	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 7.5
No.of Well Volumes (based on current water level) 3
Was well pumped/bailed dry? No

Equipment used:
Bailer type Disposable 'Dedicated Bailer ____
Pump type ____ 'Dedicated Bailer ____
If not dedicated, method of cleaning ____

D.) FIELD MEASUREMENT

Weather Conditions cloudy 35°
Field Measurments (after stabilization):
Temperature 10 Units ____
Equipment Used HACH COMPANY POCKET PAL
pH 7.3
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 1520 Units ____
Equipment Used HACH COMPANY POCKET PAL

Comments ____

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY OF MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-4 Upgradient ____
Downgradient V

Name of person sampling RMF

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? yes Standing Water or Litter? No
If no, explain ____ If yes, explain ____

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 693.22 Ground Elevation 691.29
Depth of Well 24.93 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	3/6/07	21.6	
*After Purging		22.6	
*Before Sampling	3/6/07 5:45	22.0	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 0.5
No.of Well Volumes (based on current water level) 6
Was well pumped/bailed dry? yes

Equipment used:
Bailer type Disposable 'Dedicated Bailer ____
Pump type ____ 'Dedicated Bailer ____
If not dedicated, method of cleaning ____

D.) FIELD MEASUREMENT

Weather Conditions Cloudy 35°
Field Measurments (after stabilization):
Temperature 14 Units ____
Equipment Used HACH COMPANY POCKET PAL
pH 7.2
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 751 Units ____
Equipment Used HACH COMPANY POCKET PAL

Comments ____

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY of MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-6 Upgradient ✓
Downgradient

Name of person sampling RMF

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 716.63 Ground Elevation 714.65
Depth of Well 48.98 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	3/6/06	44.7	
*After Purging		47.0	
*Before Sampling	3/6/06 6:10pm	45.0	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 1
No.of Well Volumes (based on current water level) 1
Was well pumped/bailed dry? dry

Equipment used:
Bailer type Disposable 'Dedicated Bailer
Pump type 'Dedicated Bailer
If not dedicated, method of cleaning

D.) FIELD MEASUREMENT

Weather Conditions cloudy 35°
Field Measurments (after stabilization):
Temperature 13 Units
Equipment Used HACH COMPANY POCKET PAL
pH 7.5
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 812 Units
Equipment Used HACH COMPANY POCKET PAL

Comments

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY OF MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-7 Upgradient ✓
Downgradient

Name of person sampling RMF

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? Yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 716.65 Ground Elevation 714.40
Depth of Well 22.25 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	3/6/07	21.98	
*After Purging			
*Before Sampling			

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) N/A
No.of Well Volumes (based on current water level)
Was well pumped/bailed dry?

Equipment used:
Bailer type 'Dedicated Bailer
Pump type 'Dedicated Bailer
If not dedicated, method of cleaning

D.) FIELD MEASUREMENT

Weather Conditions
Field Measurments (after stabilization):
Temperature Units
Equipment Used HACH COMPANY POCKET PAL
pH
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions Units
Equipment Used HACH COMPANY POCKET PAL

Comments

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

CITY OF MUSCATINE C&D LANDFILL
70-SDP-4-78C
MONITORING WELL SAMPLING RESULTS

SAMPLING DATE: 10/15/2007

PARAMETER	MCL	D.G.W MW 2	D.G.W MW 3	D.G.W MW 4	U.G.W MW 6	U.G.W MW 7
ug/L						
Benzene *	5	NT	NT	NT	NT	NT
Carbon tetrachloride *	5	NT	NT	NT	NT	NT
1,4-Dichlorobenzene *	0.6	NT	NT	NT	NT	NT
1,2-Dichloroethane *	5	NT	NT	NT	NT	NT
1,1-Dichloroethylene *	7	NT	NT	NT	NT	NT
1,1,1-Trichloroethane *	200	NT	NT	NT	NT	NT
Vinyl Chloride	2	NT	NT	NT	NT	NT
cis-1,2-Dichloroethylene	70	NT	NT	NT	NT	NT
Tetrachloroethylene *	5	NT	NT	NT	NT	NT
Trichloroethylene *	5	NT	NT	NT	NT	NT
mg/L						
Arsenic, dissolved	0.05	NT	NT	NT	NT	NT
Barium, dissolved	2	NT	NT	NT	NT	NT
Cadmium, dissolved	0.005	NT	NT	NT	NT	NT
Chromium, dissolved	0.1	NT	NT	NT	NT	NT
Copper, dissolved	1.3	NT	NT	NT	NT	NT
Zinc, dissolved	5	NT	NT	NT	NT	NT
Lead, dissolved	0.015	NT	NT	NT	NT	NT
Mercury, dissolved	0.002	NT	NT	NT	NT	NT
Magnisium, dissolved	---	NT	NT	NT	NT	NT
Iron, dissolved	0.3	0.209	2.06	0.183	<0.100	DRY
Chloride	250	<10	74	36	58	DRY
Nitrogen, Ammonia	---	1.3	1.4	<1.0	<1.0	DRY
Chemical Oxygen Dema	---	<10	17	<10	<10	DRY
Phenols	---	<0.100	<0.100	<0.100	<0.100	DRY
TOX	---	<0.010	0.028	0.023	<0.010	DRY
pH	6.5-8.5	7.5	7.2	7.4	7.3	DRY
Temperature, celsius	---	17	16	16	14	DRY
Conductivity	---	628	1549	763	862	DRY

Keystone
LABORATORIES, INC.

ACCREDITED IN ACCORDANCE WITH nelac

MEMBER ACIL

RECEIVED NOV 1 2 2007

ANALYTICAL REPORT

November 02, 2007

Work Order: 17J0984

Report To	Work Order Information
Todd Whipple Fox Engineering Associates, Inc. 1601 Golden Aspen Drive, Suite 103 Ames, IA 50010	Date Received: 10/18/2007 9:40AM Collector: Freeman, Richard Phone: (515) 233-0000 PO Number:

Project : City of Muscatine C & D Landfill-Fall

Project Number: 6008-06B

Analyte	Result	MRL	Batch	Method	Analyst	Analyzed	Qualifier
17J0984-01 MW-2				Matrix:Water	Collected: 10/16/07 10:50		
Total Organic Halogens (TOX)	<0.010 mg/l	0.010	1J73140	EPA 9020	TVK	11/01/07 14:17	
Chloride	<10 mg/l	10	1J72303	USGS I-1184-85	DRB	10/23/07 8:29	
Chemical Oxygen Demand	<10 mg/l	10	1J72210	EPA 410.4	SAA	10/22/07 15:16	
Nitrogen, Ammonia	**1.3 mg/l**	**1.0**	1J72209	SM 4500-NH3 F	SAA	10/22/07 15:14	
Phenols, total	<0.100 mg/l	0.100	1J73004	EPA 9065	WAS	10/31/07 15:36	
Iron, dissolved	**0.209 mg/l**	**0.100**	1J72304	EPA 6010B	RVV	10/24/07 13:52	
17J0984-02 MW-3				Matrix:Water	Collected: 10/16/07 11:00		
Total Organic Halogens (TOX)	**0.028 mg/l**	**0.010**	1J73141	EPA 9020	TVK	11/01/07 14:20	
Chloride	**74 mg/l**	**10**	1J72303	USGS I-1184-85	DRB	10/23/07 8:29	
Chemical Oxygen Demand	**17 mg/l**	**10**	1J72210	EPA 410.4	SAA	10/22/07 15:16	
Nitrogen, Ammonia	**1.4 mg/l**	**1.0**	1J72209	SM 4500-NH3 F	SAA	10/22/07 15:14	
Phenols, total	<0.100 mg/l	0.100	1J73004	EPA 9065	WAS	10/31/07 15:36	
Iron, dissolved	**2.06 mg/l**	**0.100**	1J72304	EPA 6010B	RVV	10/24/07 13:56	
17J0984-03 MW-4				Matrix:Water	Collected: 10/16/07 10:35		
Total Organic Halogens (TOX)	**0.023 mg/l**	**0.010**	1K70127	EPA 9020	TVK	11/01/07 13:37	
Chloride	**36 mg/l**	**10**	1J72303	USGS I-1184-85	DRB	10/23/07 8:29	
Chemical Oxygen Demand	<10 mg/l	10	1J72210	EPA 410.4	SAA	10/22/07 15:16	
Nitrogen, Ammonia	<1.0 mg/l	1.0	1J72209	SM 4500-NH3 F	SAA	10/22/07 15:14	
Phenols, total	<0.100 mg/l	0.100	1J73004	EPA 9065	WAS	10/31/07 15:36	
Iron, dissolved	**0.183 mg/l**	**0.100**	1J72304	EPA 6010B	RVV	10/24/07 14:10	
17J0984-04 MW-6				Matrix:Water	Collected: 10/16/07 09:45		
Total Organic Halogens (TOX)	<0.010 mg/l	0.010	1K70126	EPA 9020	TVK	11/01/07 13:27	
Chloride	**58 mg/l**	**10**	1J72303	USGS I-1184-85	DRB	10/23/07 8:29	
Chemical Oxygen Demand	<10 mg/l	10	1J72210	EPA 410.4	SAA	10/22/07 15:16	
Nitrogen, Ammonia	<1.0 mg/l	1.0	1J72209	SM 4500-NH3 F	SAA	10/22/07 15:14	
Phenols, total	<0.100 mg/l	0.100	1J73004	EPA 9065	WAS	10/31/07 15:36	
Iron, dissolved	<0.100 mg/l	0.100	1J72304	EPA 6010B	RVV	10/24/07 14:14	

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

November 02, 2007
Page 2 of 12

Work Order: 17J0984

17J0984-04	MW-6	Matrix:Water	Collected: 10/16/07 09:45

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Samples were preserved in accordance with 40 CFR for pH adjustment unless otherwise noted. MRL= Method Reporting Limit.

Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 16H0220 - 1H60203										
Cal Standard (16H0220-CAL1)				Prepared & Analyzed: 08/02/06						
Phenols, total	-0.00848		mg/l	0.00000						
Cal Standard (16H0220-CAL2)				Prepared & Analyzed: 08/02/06						
Phenols, total	0.0239		mg/l	0.0250800		95.2				
Cal Standard (16H0220-CAL3)				Prepared & Analyzed: 08/02/06						
Phenols, total	0.107		mg/l	0.100300		107				
Cal Standard (16H0220-CAL4)				Prepared & Analyzed: 08/02/06						
Phenols, total	0.401		mg/l	0.401200		100				
Cal Standard (16H0220-CAL5)				Prepared & Analyzed: 08/02/06						
Phenols, total	1.00		mg/l	1.00300		100				
Cal Standard (16H0220-CAL6)				Prepared & Analyzed: 08/02/06						
Phenols, total	2.00		mg/l	2.00600		99.6				
Calibration Check (16H0220-CCV1)				Prepared & Analyzed: 08/02/06						
Phenols, total	0.0940		mg/l	0.100000		94.0	90-110			
Batch 17A1613 - 1A71617										
Cal Standard (17A1613-CAL1)				Prepared & Analyzed: 01/16/07						
Chemical Oxygen Demand	-2.35		mg/l	0.00000						
Cal Standard (17A1613-CAL2)				Prepared & Analyzed: 01/16/07						
Chemical Oxygen Demand	12.3		mg/l	10.0000		123				

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 17A1613 - 1A71617										
Cal Standard (17A1613-CAL3)				Prepared & Analyzed: 01/16/07						
Chemical Oxygen Demand	21.9		mg/l	20.0000		110				
Cal Standard (17A1613-CAL4)				Prepared & Analyzed: 01/16/07						
Chemical Oxygen Demand	74.0		mg/l	75.0000		98.6				
Cal Standard (17A1613-CAL5)				Prepared & Analyzed: 01/16/07						
Chemical Oxygen Demand	97.6		mg/l	100.000		97.6				
Cal Standard (17A1613-CAL6)				Prepared & Analyzed: 01/16/07						
Chemical Oxygen Demand	152		mg/l	150.000		101				
Batch 17J2203 - 1J72209										
Calibration Check (17J2203-CCV1)				Prepared & Analyzed: 10/22/07						
Nitrogen, Ammonia	5.57		mg/l	5.00000		111	80-120			
Calibration Check (17J2203-CCV2)				Prepared & Analyzed: 10/22/07						
Nitrogen, Ammonia	5.41		mg/l	5.00000		108	80-120			
Initial Cal Check (17J2203-ICV1)				Prepared & Analyzed: 10/22/07						
Nitrogen, Ammonia	5.26		mg/l	5.00000		105	80-120			
Batch 17J2205 - 1J72211										
Calibration Check (17J2205-CCV1)				Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	77.8		mg/l	75.0000		104	90-110			

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 17J2205 - 1J72211										
Calibration Check (17J2205-CCV2)				Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	74.6		mg/l	75.0000		99.5	90-110			
Calibration Check (17J2205-CCV3)				Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	74.0		mg/l	75.0000		98.6	90-110			
Calibration Check (17J2205-CCV4)				Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	73.6		mg/l	75.0000		98.2	90-110			
Batch 17J3002 - 1J73004										
Calibration Check (17J3002-CCV1)				Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	0.0886		mg/l	0.100300		88.3	80-120			
Initial Cal Blank (17J3002-ICB1)				Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	-0.00848		mg/l							
Initial Cal Check (17J3002-ICV1)				Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	0.0913		mg/l	0.100300		91.0	80-120			
Batch 1J72209 - Wet Chem Preparation										
Blank (1J72209-BLK1)				Prepared & Analyzed: 10/22/07						
Nitrogen, Ammonia	ND	1.0	mg/l							
Matrix Spike (1J72209-MS1)		**Source: 17J0985-16**		Prepared & Analyzed: 10/22/07						
Nitrogen, Ammonia	5.39	1.0	mg/l	5.00000	ND	108	64-129			

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1J72209 - Wet Chem Preparation										
Matrix Spike Dup (1J72209-MSD1)	**Source: 17J0985-16**			Prepared & Analyzed: 10/22/07						
Nitrogen, Ammonia	5.22	1.0	mg/l	5.00000	ND	104	64-129	3.20	12	
Batch 1J72210 - Wet Chem Preparation										
Blank (1J72210-BLK1)				Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	ND	10	mg/l							
LCS (1J72210-BS1)				Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	75.9	10	mg/l	75.0000		101	78-117			
Matrix Spike (1J72210-MS1)	**Source: 17J0985-09**			Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	49.5	10	mg/l	42.8571	5.95	102	60-139			
Matrix Spike Dup (1J72210-MSD1)	**Source: 17J0985-09**			Prepared & Analyzed: 10/22/07						
Chemical Oxygen Demand	50.2	10	mg/l	42.8571	5.95	103	60-139	1.46	26	
Batch 1J72303 - Wet Chem Preparation										
Blank (1J72303-BLK1)				Prepared & Analyzed: 10/23/07						
Chloride	ND	10	mg/l							
Matrix Spike (1J72303-MS1)	**Source: 17J0984-03**			Prepared & Analyzed: 10/23/07						
Chloride	58.2	10	mg/l	25.0000	36.2	88.0	75-116			
Matrix Spike Dup (1J72303-MSD1)	**Source: 17J0984-03**			Prepared & Analyzed: 10/23/07						
Chloride	58.7	10	mg/l	25.0000	36.2	90.0	75-116	0.855	10	

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1J72303 - Wet Chem Preparation										
Reference (1J72303-SRM1)				Prepared & Analyzed: 10/23/07						
Chloride	21.0	10	mg/l	20.0000		105	90-110			
Batch 1J73004 - Wet Chem Preparation										
Blank (1J73004-BLK1)				Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	ND	0.100	mg/l							
LCS (1J73004-BS1)				Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	0.0832	0.100	mg/l	0.100300		83.0	60-125			
Duplicate (1J73004-DUP1)		Source: 17J0984-03		Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	ND	0.100	mg/l		ND				20	
Matrix Spike (1J73004-MS1)		Source: 17J0984-04		Prepared: 10/30/07 Analyzed: 10/31/07						
Phenols, total	0.0940	0.100	mg/l	0.100300	ND	93.7	60-140			
Batch 1J73140 - TOX/TX/EOX										
Blank (1J73140-BLK1)				Prepared & Analyzed: 10/31/07						
Total Organic Halogens (TOX)	ND	0.010	mg/l							
LCS (1J73140-BS1)				Prepared & Analyzed: 10/31/07						
Total Organic Halogens (TOX)	0.0918	0.010	mg/l	0.103000		89.1	73-126			
Reference (1J73140-SRM1)				Prepared & Analyzed: 10/31/07						
Total Organic Halogens (TOX)	0.0989	0.010	mg/l	0.103000		96.0	90-110			

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1J73141 - TOX/TX/EOX										
Blank (1J73141-BLK1)				Prepared & Analyzed: 10/31/07						
Total Organic Halogens (TOX)	ND	0.010	mg/l							
LCS (1J73141-BS1)				Prepared & Analyzed: 10/31/07						
Total Organic Halogens (TOX)	0.0982	0.010	mg/l	0.103000		95.3	73-126			
Reference (1J73141-SRM1)				Prepared & Analyzed: 10/31/07						
Total Organic Halogens (TOX)	0.1026	0.010	mg/l	0.103000		99.7	90-110			
Batch 1K70126 - TOX/TX/EOX										
Blank (1K70126-BLK1)				Prepared & Analyzed: 11/01/07						
Total Organic Halogens (TOX)	ND	0.010	mg/l							
LCS (1K70126-BS1)				Prepared & Analyzed: 11/01/07						
Total Organic Halogens (TOX)	0.0993	0.010	mg/l	0.103000		96.4	73-126			
Reference (1K70126-SRM1)				Prepared & Analyzed: 11/01/07						
Total Organic Halogens (TOX)	0.0993	0.010	mg/l	0.103000		96.4	90-110			
Reference (1K70126-SRM2)				Prepared: 11/01/07 Analyzed: 11/02/07						
Total Organic Halogens (TOX)	0.1003	0.010	mg/l	0.103000		97.4	90-110			
Batch 1K70127 - TOX/TX/EOX										
Blank (1K70127-BLK1)				Prepared & Analyzed: 11/01/07						
Total Organic Halogens (TOX)	ND	0.010	mg/l							

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Conventional Chemistry Parameters - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1K70127 - TOX/TX/EOX										
LCS (1K70127-BS1)				Prepared & Analyzed: 11/01/07						
Total Organic Halogens (TOX)	0.1081	0.010	mg/l	0.103000		105	73-126			
Reference (1K70127-SRM1)				Prepared & Analyzed: 11/01/07						
Total Organic Halogens (TOX)	0.1034	0.010	mg/l	0.103000		100	90-110			
Reference (1K70127-SRM2)				Prepared: 11/01/07 Analyzed: 11/02/07						
Total Organic Halogens (TOX)	0.1054	0.010	mg/l	0.103000		102	90-110			

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Dissolved Metals - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 17J2404 - 1J72304										
Calibration Blank (17J2404-CCB1)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	0.00270		mg/l	0.00000						
Calibration Blank (17J2404-CCB2)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	0.00570		mg/l	0.00000						
Calibration Blank (17J2404-CCB3)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	-0.0100		mg/l	0.00000						
Calibration Check (17J2404-CCV1)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	21.5		mg/l	21.0000		102	90-110			
Calibration Check (17J2404-CCV2)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	21.4		mg/l	21.0000		102	90-110			
Calibration Check (17J2404-CCV3)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	21.1		mg/l	21.0000		100	90-110			
High Cal Check (17J2404-HCV2)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	21.5		mg/l	20.0000		108	90-110			
Initial Cal Blank (17J2404-ICB1)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	0.0158		mg/l	0.00000						
Initial Cal Check (17J2404-ICV1)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	21.7		mg/l	21.0000		103	90-110			
Secondary Cal Check (17J2404-SCV1)				Prepared & Analyzed: 10/24/07						
Iron, dissolved	2.64		mg/l	2.50000		106	90-110			

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

Determination of Dissolved Metals - Quality Control
Keystone Laboratories, Inc. - Newton

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1J72304 - Dissolved Metal Prep										
Blank (1J72304-BLK1)				Prepared: 10/23/07 Analyzed: 10/24/07						
Iron, dissolved	ND	0.100	mg/l							
Matrix Spike (1J72304-MS1)		Source: 17J0812-06		Prepared: 10/23/07 Analyzed: 10/24/07						
Iron, dissolved	0.382	0.100	mg/l	0.200000	0.164	109	79-135			
Matrix Spike Dup (1J72304-MSD1)		Source: 17J0812-06		Prepared: 10/23/07 Analyzed: 10/24/07						
Iron, dissolved	0.376	0.100	mg/l	0.200000	0.164	106	79-135	1.64	11	

ND = Non Detect; REC= Recovery; RPD= Relative Percent Difference

Certified Analyses included in this Report

Method/Matrix	Analyte	Certifications
EPA 410.4 in Water		
	Chemical Oxygen Demand	IA-NT,KS-NT,NELAC
EPA 6010B in Water		
	Iron, dissolved	IA-NT,KS-NT,NELAC
EPA 9020 in Water		
	Total Organic Halogens (TOX)	IA-NT,NELAC
EPA 9065 in Water		
	Phenols, total	IA-NT,KS-NT,NELAC
SM 4500-NH3 F in Water		
	Nitrogen, Ammonia	IA-NT
USGS I-1184-85 in Water		
	Chloride	IA-NT

Code	Description	Number	Expires
IA-NT	Iowa Department of Natural Resources	095	02/01/2008
KS-NT	Kansas Department of Health and Environment	E-10287	07/31/2008
NELAC	New Jersey Department of Environmental Protection	IA001	06/30/2008

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Fox Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, IA 50010

Work Order: 17J0984

End of Report

Sue Thompson

Keystone Laboratories, Inc.

Sue Thompson
Project Manager I

CHAIN OF CUSTODY RECORD

Keystone LABORATORIES, INC.

☐ 600 E. 17th St. S.
Newton, IA 50208
Phone: 641-792-8451
Fax: 641-792-7989

☐ 3012 Ansborough Ave.
Waterloo, IA 50701
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Fax: 319-235-2480

☐ 1304 Adams
Kansas City, KS 66103
Phone: 913-321-7856
Fax: 913-321-7937

PAGE 1 OF 1

PRINT OR TYPE INFORMATION BELOW

SAMPLER: Richard Freeman
SITE NAME: Muscatine CE'D
ADDRESS:
CITY/ST/ZIP:
PHONE:

REPORT TO:
NAME: Todd Whipple
COMPANY NAME: Fox Engr
ADDRESS:
CITY/ST/ZIP: Ames, IA
PHONE:
FAX:

BILL TO:
NAME: Laura Lee 9015 - Manager
COMPANY NAME: City of Muscatine
ADDRESS: 1000 S. Houser St.
CITY/ST/ZIP: Muscatine, IA 52761
PHONE: 563-263-9689

Keystone Quote No.: (If Applicable)

CLIENT SAMPLE NUMBER	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	MATRIX	GRAB/COMPOSITE	ANALYSES REQUIRED: 40 ml VOA	ANALYSES REQUIRED: 1 L Amber	LAB USE ONLY: LABORATORY SAMPLE NUMBER
MW 2	10/16/07	1050 AM	Monitoring Well	2	W	X	X	X	01
MW 3		11 AM		3					02
MW 4		1035 AM		4					03
MW 6		945 AM		6					04

LABORATORY WORK ORDER NO.: 17J0984

SAMPLE TEMPERATURE UPON RECEIPT: °C

SAMPLE CONDITION/COMMENTS:

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Date / Time	Turn-Around:
Richard Freeman	10/18/07 9:40AM			☑ Standard ☐ Rush (Contact Lab Prior to Submission)
Relinquished by: (Signature)	Date / Time	Received for Lab by: (Signature)	Date 10-18-07 Time 9:40	Remarks:

Original - Return with Report • Yellow - Lab Copy • Pink - Sampler Copy

FORM: CCR 7-97

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY of MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-2 Upgradient ____
Downgradient ✓

Name of person sampling ____

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? Yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 640.86 Ground Elevation 638.70
Depth of Well 42.16 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	10/15/07	7.6	
*After Purging		28.5	
*Before Sampling	10/16/07 10:50am	8.0	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 10
No.of Well Volumes (based on current water level) 2
Was well pumped/bailed dry? No

Equipment used:
Bailer type Disposable poly 'Dedicated Bailer ____
Pump type ____ 'Dedicated Bailer ____
If not dedicated, method of cleaning ____

D.) FIELD MEASUREMENT

Weather Conditions cloudy 55°
Field Measurments (after stabilization):
Temperature 17 Units ____
Equipment Used HACH COMPANY POCKET PAL
pH 7.5
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 628 Units ____
Equipment Used HACH COMPANY POCKET PAL

Comments ____

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

542-1322

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY OF MUSCATINE C & D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-3 Upgradient ____
Downgradient ✓

Name of person sampling ____

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? yes Standing Water or Litter? No
If no, explain ____ If yes, explain ____

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 640.36 Ground Elevation 638.30
Depth of Well 22.06 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	10/15/07	11.3	
*After Purging		20.3	
*Before Sampling	10/16/07 11:00	11.3	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 4
No.of Well Volumes (based on current water level) 2
Was well pumped/bailed dry? yes

Equipment used:
Bailer type Disposable poly 'Dedicated Bailer ____
Pump type ____ 'Dedicated Bailer ____
If not dedicated, method of cleaning ____

D.) FIELD MEASUREMENT

Weather Conditions Cloudy 55°
Field Measurments (after stabilization):
Temperature 16 Units ____
Equipment Used HACH COMPANY POCKET PAL
pH 7.2
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 1549 Units ____
Equipment Used HACH COMPANY POCKET PAL

Comments ____

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY OF MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-4 Upgradient _____
Downgradient V

Name of person sampling _____

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? Yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 693.22 Ground Elevation 691.29
Depth of Well 24.43 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	10/15/2007	21.55	
*After Purging		24~~5~~.0	
*Before Sampling	10/15/07 10:35	21.6	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 0.5
No.of Well Volumes (based on current water level) 1
Was well pumped/bailed dry? Yes

Equipment used:
Bailer type Disposable 'Dedicated Bailer _____
Pump type _____ 'Dedicated Bailer _____
If not dedicated, method of cleaning _____

D.) FIELD MEASUREMENT

Weather Conditions Cloudy 55°
Field Measurments (after stabilization):
Temperature 16 Units _____
Equipment Used HACH COMPANY POCKET PAL
pH 7.4
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 763 Units _____
Equipment Used HACH COMPANY POCKET PAL

Comments _____

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY of MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-6 Upgradient ✓
Downgradient

Name of person sampling

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 716.63 Ground Elevation 714.65
Depth of Well 48.98 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	10/15/07	44.42	
*After Purging		47.0	
*Before Sampling	10/16/07 9:45	44.5	

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) 1
No.of Well Volumes (based on current water level) 1
Was well pumped/bailed dry? yes

Equipment used:
Bailer type Disposable 'Dedicated Bailer
Pump type 'Dedicated Bailer
If not dedicated, method of cleaning

D.) FIELD MEASUREMENT

Weather Conditions Cloudy 55°
Field Measurments (after stabilization):
Temperature 14 Units
Equipment Used HACH COMPANY POCKET PAL
pH 7.3
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions 862 Units
Equipment Used HACH COMPANY POCKET PAL

Comments

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

*Omit if only measuring groundwater elevations.

FORM FOR
GROUNDWATER SAMPLING AND/OR
GROUNDWATER ELEVATION MEASUREMENT

Site Name CITY OF MUSCATINE C&D Landfill Permit No. 70-SDP-4-78C

Monitoring Well/Piezometer No. MW-7 Upgradient ✓
Downgradient

Name of person sampling

A.) MONITORING WELL/PIEZOMETER CONDITIONS

Well/Piezometer Properly Capped? Yes Standing Water or Litter? No
If no, explain — If yes, explain —

B.) GROUNDWATER ELEVATION MEASUREMENT (+/- 0.01 foot, MSL)

Elevation: Top of inner well casing 716.65 Ground Elevation 714.40
Depth of Well 22.25 Inside Casing Diameter (in inches) 2.0"
Equipment Used SOLINST

Groundwater Level (+/- 0.01 foot below top of inner casing, MSL):

	Date/Time	Depth to Groundwater	Groundwater Elevation
Before Purging	10/15/07	21.85	
*After Purging			
*Before Sampling			

C.) WELL PURGING

Quantity of Water Removed from Well (gallons) N/A
No.of Well Volumes (based on current water level)
Was well pumped/bailed dry?

Equipment used:
Bailer type 'Dedicated Bailer
Pump type 'Dedicated Bailer
If not dedicated, method of cleaning

D.) FIELD MEASUREMENT

Weather Conditions
Field Measurments (after stabilization):
Temperature Units
Equipment Used HACH COMPANY POCKET PAL
pH
Equipment Used HACH COMPANY POCKET PAL
Specific Conditions Units
Equipment Used HACH COMPANY POCKET PAL

Comments

NOTE: Attach Laboratory Report and 8-12" x 11" site plan showing locations of all surface and groundwater monitoring points. One map per sampling round.

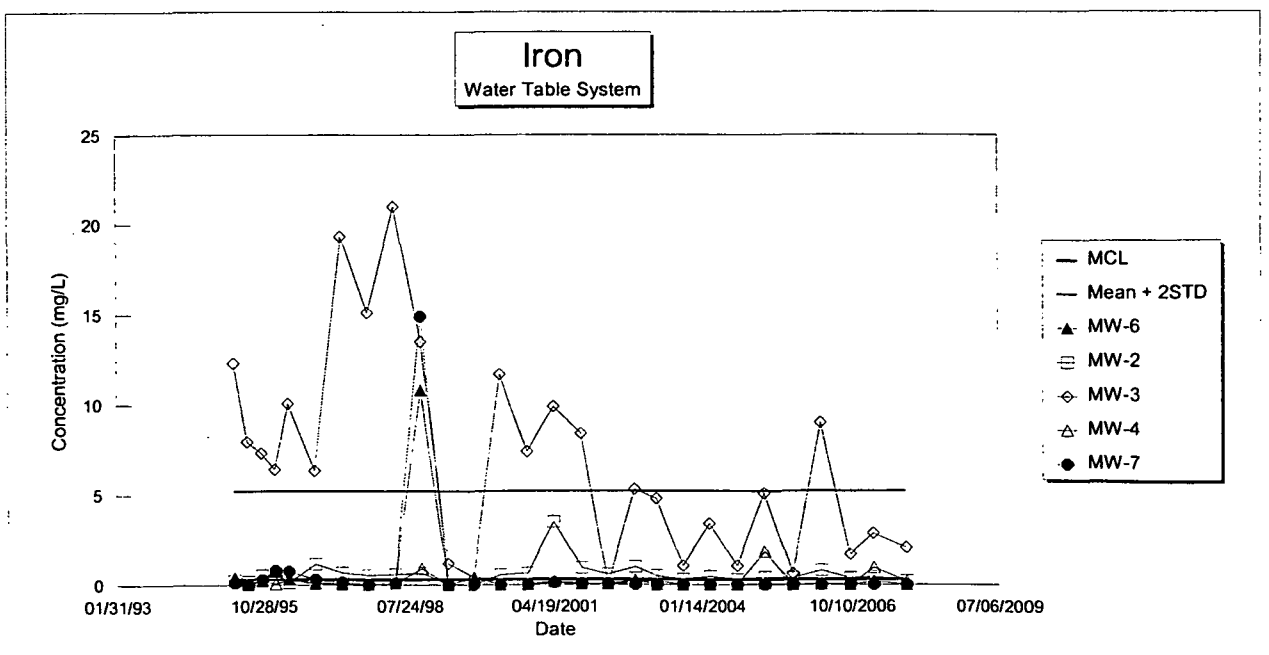
*Omit if only measuring groundwater elevations.

ATTACHMENT D

Concentration versus Time Graphs

GROUNDWATER SYSTEM
MUSCATINE C & D LANDFILL
70-SDP-4-78C
CONCENTRATION VERSUS TIME

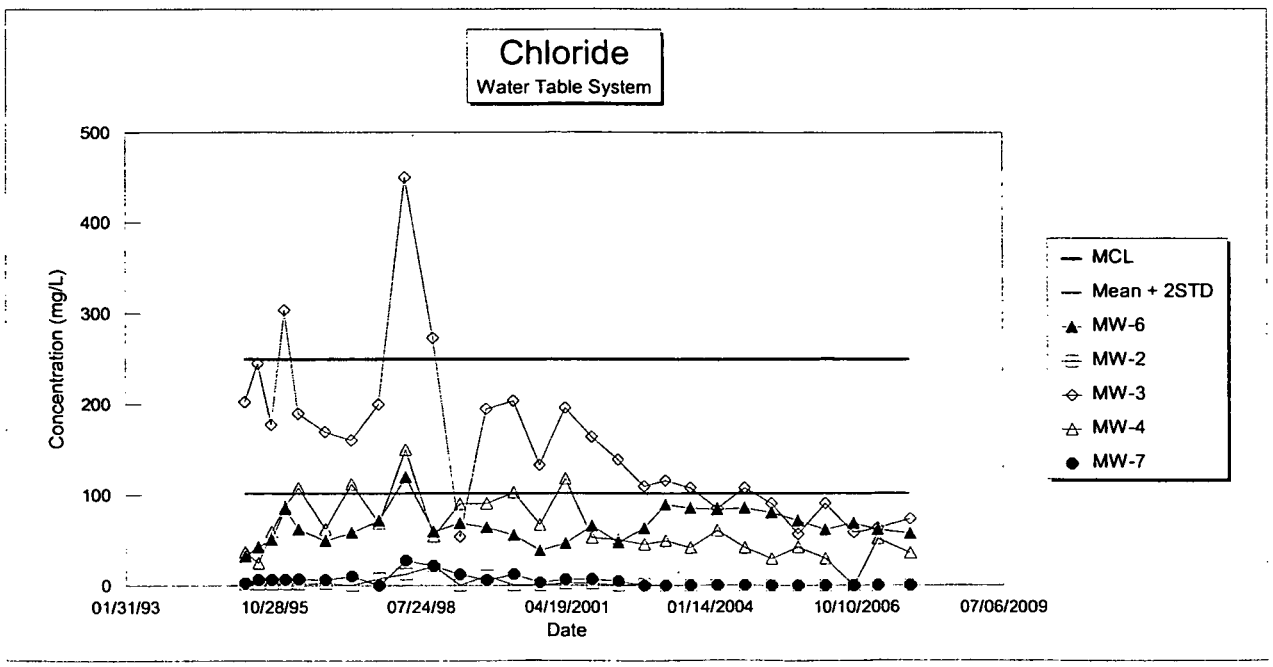
	PARAMETER	MCL	Mean + 2STD	U.W.T. MW 6	D.W.T. MW 2	D.W.T. MW 3	D.W.T. MW 4	D.W.T. MW 7
		mg/L						
04/15/95	Iron, dissolved	0.3	5.215	0.41	0.25	12.3	0.27	0.11
07/15/95	Iron, dissolved	0.3	5.215	0.02	0.18	7.94	0.05	0.01
10/15/95	Iron, dissolved	0.3	5.215	0.21	0.54	7.31	0.25	0.29
01/15/96	Iron, dissolved	0.3	5.215	0.74	0.59	6.41	0.06	0.81
04/15/96	Iron, dissolved	0.3	5.215	0.33	0.12	10.05	0.3	0.76
10/15/96	Iron, dissolved	0.3	5.215	0.07	1.16	6.33	0.09	0.31
04/15/97	Iron, dissolved	0.3	5.215	0.04	0.69	19.32	0.12	0.15
10/15/97	Iron, dissolved	0.3	5.215	0.015	0.54	15.1	0.015	dry
04/15/98	Iron, dissolved	0.3	5.215	0.1	0.6	21	0.1	0.1
10/15/98	Iron, dissolved	0.3	5.215	10.8	0.661	13.5	0.914	14.9
04/15/99	Iron, dissolved	0.3	5.215	0.0022	0.046	1.19	0.0022	0.0022
10/15/99	Iron, dissolved	0.3	5.215	0.413	0.0022	0.412	0.0022	0.0022
04/15/2000	Iron, dissolved	0.3	5.215	0.0022	0.583	11.7	0.0022	0.0022
10/15/2000	Iron, dissolved	0.3	5.215	0.008	0.653	7.4	0.014	0.0022
04/15/2001	Iron, dissolved	0.3	5.215	0.19	3.5	9.9	0.16	0.11
10/15/2001	Iron, dissolved	0.3	5.215	0.05	0.95	8.4	0.05	0.05
04/15/2002	Iron, dissolved	0.3	5.215	0.06	0.6	0.06	0.06	0.06
10/15/2002	Iron, dissolved	0.3	5.215	0.27	1	5.3	0.16	dry
03/13/2003	Iron, dissolved	0.3	5.215	<0.3	0.511	4.78	0.215	dry
09/04/2003	Iron, dissolved	0.3	5.215	<0.3	0.305	1.06	<0.3	dry
03/03/2004	Iron, dissolved	0.3	5.215	<0.30	0.466	3.38	0.018	dry
09/08/2004	Iron, dissolved	0.3	5.215	<0.3	0.305	1.06	<0.3	dry
03/10/2005	Iron, dissolved	0.3	5.215	0.095	0.441	5.09	1.85	dry
09/08/2005	Iron, dissolved	0.3	5.215	<0.3	0.4	0.638	<0.3	dry
03/15/2006	Iron, dissolved	0.3	5.215	0.073	0.799	9.01	<0.030	dry
09/27/2006	Iron, dissolved	0.3	5.215	<0.030	0.371	1.69	dry	dry
03/06/2007	Iron, dissolved	0.3	5.215	0.194	0.460	2.85	0.966	dry
10/15/2007	Iron, dissolved	0.3	5.215	<0.100	0.209	2.06	0.183	dry
	Mean			0.671067	0.604721	6.972857	0.254417	1.1043
	Standard Deviation (STD)			2.272052	0.619649	5.549156	0.422419	3.570497
	Mean + 2STD			5.21517	1.844019	18.07117	1.099256	8.245294



GROUNDWATER SYSTEM
MUSCATINE C & D LANDFILL
70-SDP-4-78C
CONCENTRATION VERSUS TIME

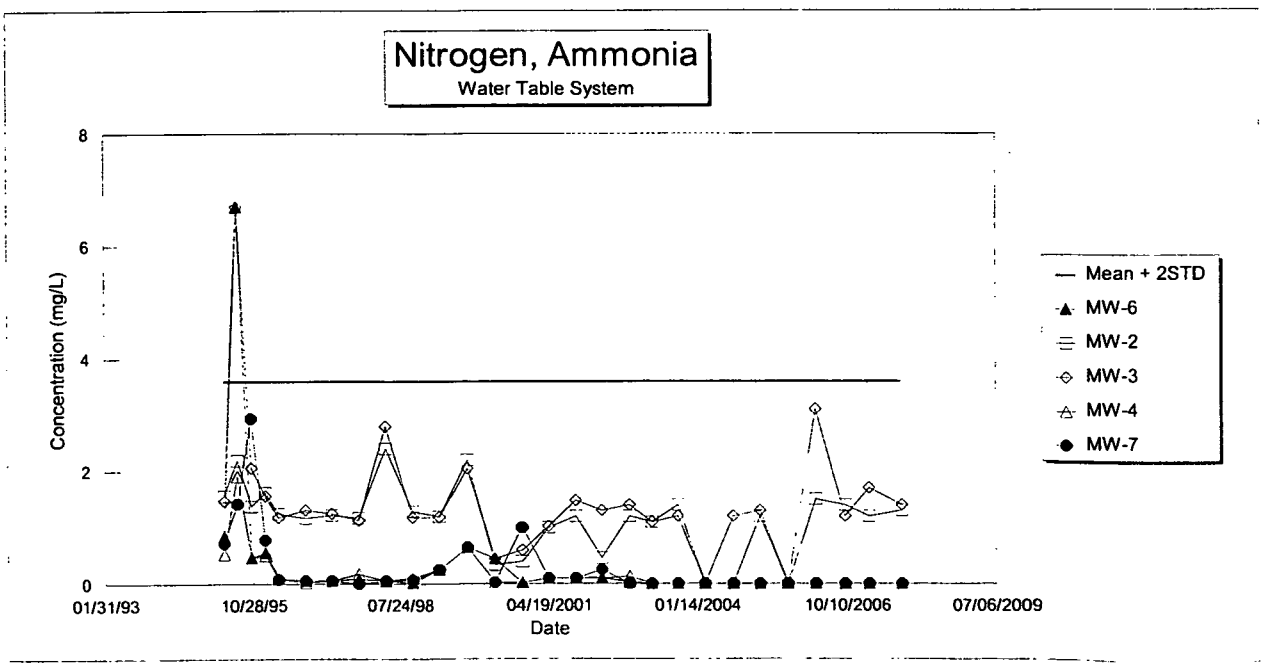
	PARAMETER	MCL mg/L	Mean + 2STD	U.W.T. MW 6	D.W.T. MW 2	D.W.T. MW 3	D.W.T. MW 4	D.W.T. MW 7
04/15/95	Chloride	250	101.862	32.5	1.8	202.5	37	2.4
07/15/95	Chloride	250	101.862	42.6	1.8	245.1	24.8	6.5
10/15/95	Chloride	250	101.862	51.1	1.7	177.5	59.8	6.6
01/15/96	Chloride	250	101.862	85.1	2.3	303.7	87.5	6.8
04/15/96	Chloride	250	101.862	62.5	2.3	190	108.2	7.2
10/15/96	Chloride	250	101.862	49.6	2.5	169.8	62.3	6.4
04/15/97	Chloride	250	101.862	58.9	0.5	160.4	112.3	10.3
10/15/97	Chloride	250	101.862	72	8	200	69	dry
04/15/98	Chloride	250	101.862	120	13	450	150	28
10/15/98	Chloride	250	101.862	60.1	21.8	273	54.6	21.8
04/15/99	Chloride	250	101.862	69.2	0.5	54.3	90.5	12.4
10/15/99	Chloride	250	101.862	64.7	10.5	195	91.1	6.2
04/15/2000	Chloride	250	101.862	55.8	0.5	204	103	12.4
10/15/2000	Chloride	250	101.862	39	0.5	133	67.4	3.37
04/15/2001	Chloride	250	101.862	46.8	2.5	196	118	6.8
10/15/2001	Chloride	250	101.862	66.3	2.5	164	53.1	7
04/15/2002	Chloride	250	101.862	48	0.5	139	51	5
10/15/2002	Chloride	250	101.862	64	1.4	110	46	dry
03/13/2003	Chloride	250	101.862	90	<10	116	50	dry
09/04/2003	Chloride	250	101.862	86	<10	108	42	dry
03/03/2004	Chloride	250	101.862	84	<10	85	61	dry
09/08/2004	Chloride	250	101.862	86	<10	108	42	dry
03/10/2005	Chloride	250	101.862	81	<10	91	30	dry
09/08/2005	Chloride	250	101.862	72	<10	57	43	dry
03/15/2006	Chloride	250	101.862	62	<10	91	30	dry
09/27/2006	Chloride	250	101.862	69	<10	59	dry	dry
03/06/2007	Chloride	250	101.862	62	<10	64	52	dry
10/15/2007	Chloride	250	101.862	58	<10	74	36	dry

Mean	65.65	4.144444	157.8679	65.61481	9.323125
Standard Deviation (STD)	18.10617	5.533858	86.3073	30.98084	6.53245
Mean + 2STD	101.8623	15.21216	330.4825	127.5765	22.38802



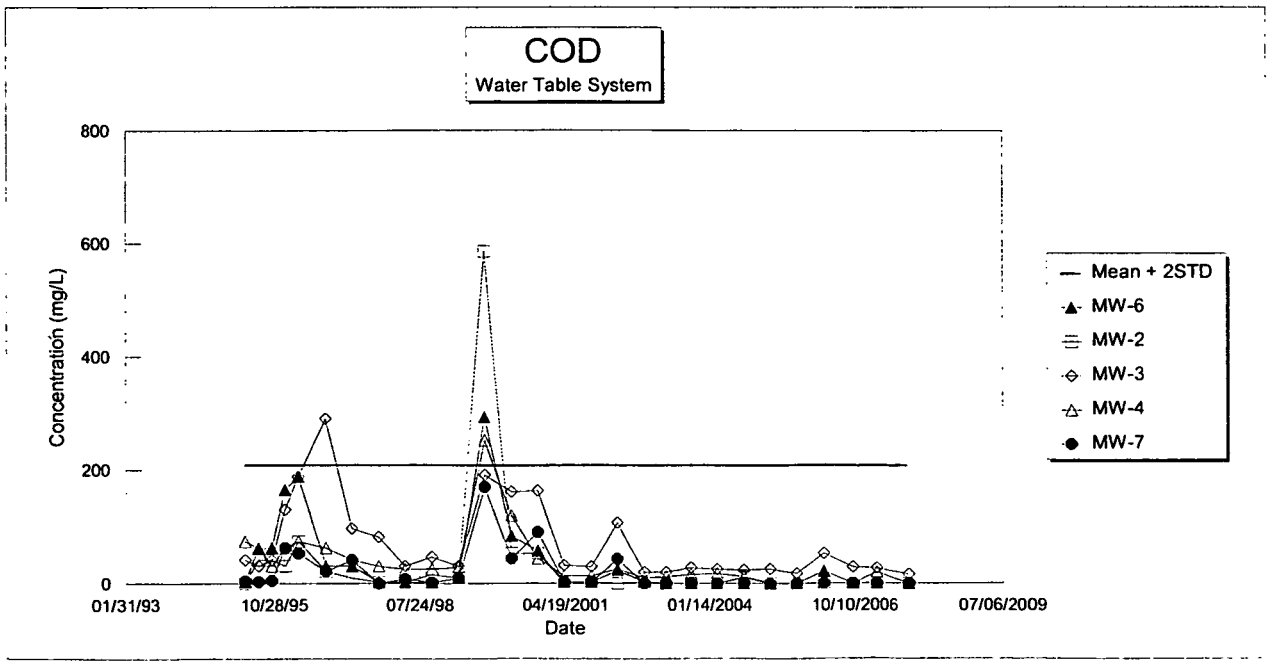
GROUNDWATER SYSTEM
MUSCATINE C & D LANDFILL
70-SDP-4-78C
CONCENTRATION VERSUS TIME

	PARAMETER	MCL mg/L	Mean + 2STD	U.W.T. MW 6	D.W.T. MW 2	D.W.T. MW 3	D.W.T. MW 4	D.W.T. MW 7
04/15/95	Nitrogen, Ammonia	---	3.596	0.86	1.56	1.47	0.53	0.72
07/15/95	Nitrogen, Ammonia	---	3.596	6.7	2.19	6.7	1.91	1.42
10/15/95	Nitrogen, Ammonia	---	3.596	0.47	1.38	2.06	0.47	2.94
01/15/96	Nitrogen, Ammonia	---	3.596	0.56	1.62	1.56	0.51	0.78
04/15/96	Nitrogen, Ammonia	---	3.596	0.1	1.25	1.18	0.1	0.08
10/15/96	Nitrogen, Ammonia	---	3.596	0.06	1.17	1.31	0.025	0.06
04/15/97	Nitrogen, Ammonia	---	3.596	0.06	1.22	1.25	0.06	0.06
10/15/97	Nitrogen, Ammonia	---	3.596	0.09	1.17	1.13	0.18	dry
04/15/98	Nitrogen, Ammonia	---	3.596	0.05	2.4	2.8	0.05	0.05
10/15/98	Nitrogen, Ammonia	---	3.596	0.025	1.29	1.18	0.108	0.067
04/15/99	Nitrogen, Ammonia	---	3.596	0.25	1.2	1.19	0.25	0.25
10/15/99	Nitrogen, Ammonia	---	3.596	0.65	2.2	2.05	0.65	0.65
04/15/2000	Nitrogen, Ammonia	---	3.596	0.448	0.336	0.448	0.025	0.025
10/15/2000	Nitrogen, Ammonia	---	3.596	0.025	0.4	0.6	0.025	1
04/15/2001	Nitrogen, Ammonia	---	3.596	0.1	1	1.02	0.1	0.1
10/15/2001	Nitrogen, Ammonia	---	3.596	0.1	1.2	1.48	0.1	0.1
04/15/2002	Nitrogen, Ammonia	---	3.596	0.11	0.46	1.3	0.1	0.254
10/15/2002	Nitrogen, Ammonia	---	3.596	0.025	1.2	1.4	0.13	dry
03/13/2003	Nitrogen, Ammonia	---	3.596	<1	1.1	1.1	<1	dry
09/04/2003	Nitrogen, Ammonia	---	3.596	<1	1.4	1.2	<1	dry
03/03/2004	Nitrogen, Ammonia	---	3.596	<1.0	<1.0	<1.0	<1.0	dry
09/08/2004	Nitrogen, Ammonia	---	3.596	<1.0	<1.0	1.2	<1.0	dry
03/10/2005	Nitrogen, Ammonia	---	3.596	<1.0	1.2	1.3	<1.0	dry
09/08/2005	Nitrogen, Ammonia	---	3.596	<1.0	<1.0	<1.0	<1.0	dry
03/15/2006	Nitrogen, Ammonia	---	3.596	<1.0	1.5	3.1	<1.0	dry
09/27/2006	Nitrogen, Ammonia	---	3.596	<1.0	1.4	1.2	dry	dry
03/06/2007	Nitrogen, Ammonia	---	3.596	<1.0	1.2	1.7	<1.0	dry
10/15/2007	Nitrogen, Ammonia	---	3.596	<1.0	1.3	1.4	<1.0	dry
	Mean			0.5935	1.29384	1.628	0.295722	0.53475
	Standard Deviation (STD)			1.501318	0.478132	1.155897	0.436515	0.741713
	Mean + 2STD			3.596137	2.250103	3.939793	1.168751	2.018176



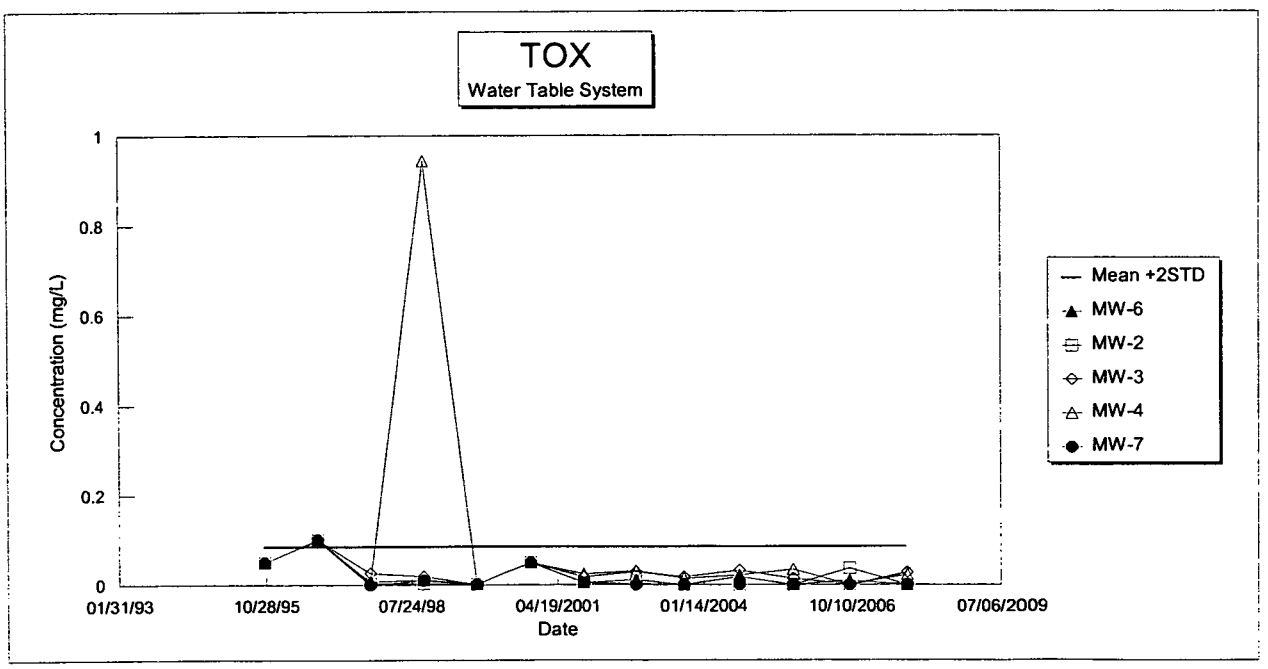
GROUNDWATER SYSTEM
MUSCATINE C & D LANDFILL
70-SDP-4-78C
CONCENTRATION VERSUS TIME

	PARAMETER	MCL mg/L	Mean + 2STD	U.W.T. MW 6	D.W.T. MW 2	D.W.T. MW 3	D.W.T. MW 4	D.W.T. MW 7
04/15/95	COD	---	208.653	2.9	0.05	42	74	4.3
07/15/95	COD	---	208.653	62	42	31	63	2.8
10/15/95	COD	---	208.653	63	42	42	31	5.1
01/15/96	COD	---	208.653	165	31	130	63	63
04/15/96	COD	---	208.653	188	74	188	74	53
10/15/96	COD	---	208.653	31	21	290	63	21
04/15/97	COD	---	208.653	31	10	97	42	42
10/15/97	COD	---	208.653	2.5	2.5	82	31	dry
04/15/98	COD	---	208.653	2.5	2.5	31	25	8
10/15/98	COD	---	208.653	2	16	47	25	2
04/15/99	COD	---	208.653	10	10	31	29	10
10/15/99	COD	---	208.653	293	585	191	252	170
04/15/2000	COD	---	208.653	84.1	53.1	162	120	44.3
10/15/2000	COD	---	208.653	57.5	53.1	164	44.3	90.7
04/15/2001	COD	---	208.653	2.5	2.5	32	14	2.5
10/15/2001	COD	---	208.653	2.5	2.5	30	14	2.5
04/15/2002	COD	---	208.653	23.8	NT	107	25.9	43.4
10/15/2002	COD	---	208.653	3	3	20	10	dry
03/13/2003	COD	---	208.653	<10	<10	20	12	dry
09/04/2003	COD	---	208.653	<10	<10	28	16	dry
03/03/2004	COD	---	208.653	<10	<10	25	18	dry
09/08/2004	COD	---	208.653	<10	11	24	12	dry
03/10/2005	COD	---	208.653	<10	<10	26	<10	dry
09/08/2005	COD	---	208.653	<10	<10	18	<10	dry
03/15/2006	COD	---	208.653	22	<10	53	<10	dry
09/27/2006	COD	---	208.653	<10	<10	29	dry	dry
03/06/2007	COD	---	208.653	<10	<10	27	20	dry
10/15/2007	COD	---	208.653	<10	<10	17	<10	dry
	Mean			55.17368	53.40278	70.85714	46.87826	35.2875
	Standard Deviation (STD)			76.73959	130.7134	68.65114	51.24076	43.49214
	Mean + 2STD			208.6529	314.8295	208.1594	149.3598	122.2718



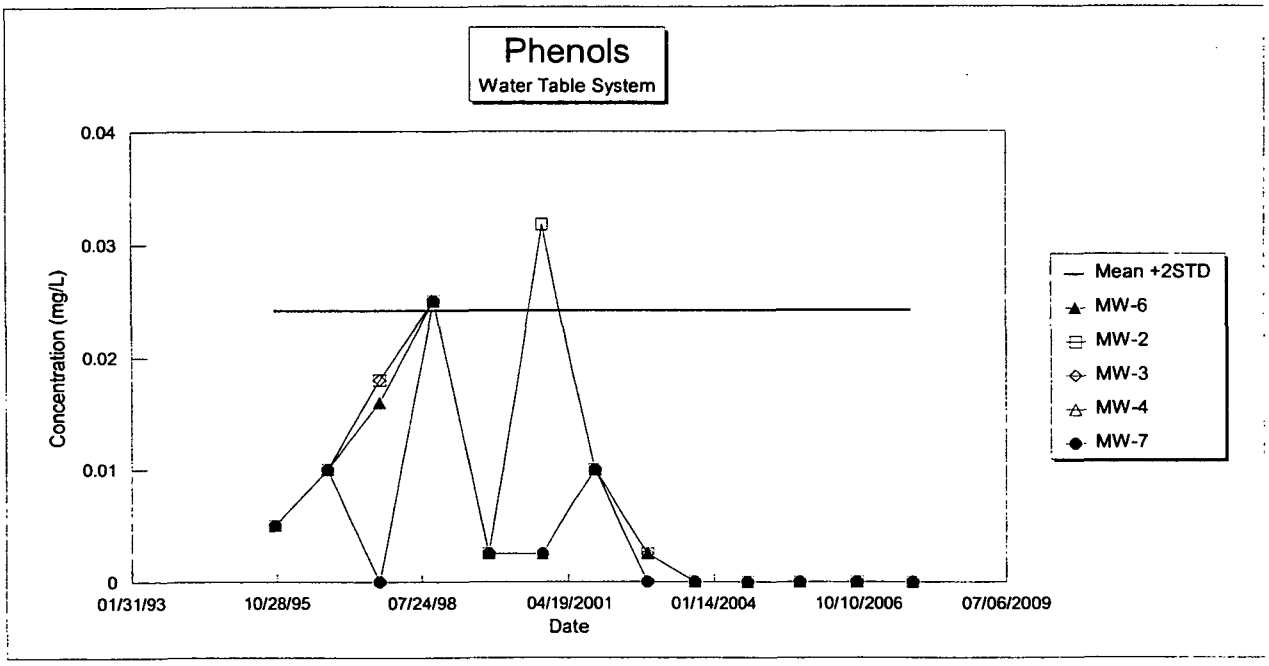
GROUNDWATER SYSTEM
MUSCATINE C & D LANDFILL
70-SDP-4-78C
CONCENTRATION VERSUS TIME

	PARAMETER	MCL mg/L	Mean + 2STD	U.W.T. MW 6	D.W.T. MW 2	D.W.T. MW 3	D.W.T. MW 4	D.W.T. MW 7
10/15/95	TOX	---	0.086	0.05	0.05	0.05	0.05	0.05
10/15/96	TOX	---	0.086	0.1	0.1	0.1	0.1	0.1
10/15/97	TOX	---	0.086	0.007	0.0025	0.026	0.007	0.0001
10/15/98	TOX	---	0.086	0.011	0.0025	0.019	0.945	0.01
10/15/99	TOX	---	0.086	0.001	0.001	0.001	0.001	0.001
10/15/2000	TOX	---	0.086	0.05	0.05	0.05	0.05	0.05
10/15/2001	TOX	---	0.086	0.005	0.005	0.018	0.024	0.005
10/15/2002	TOX	---	0.086	0.011	0.0025	0.029	0.031	dry
09/04/2003	TOX	---	0.086	<0.01	<0.01	0.018	0.014	dry
09/08/2004	TOX	---	0.086	0.018	<0.010	0.032	0.021	dry
09/08/2005	TOX	---	0.086	<0.010	<0.010	0.014	0.034	dry
09/27/2006	TOX	---	0.086	0.01	0.037	<0.010	dry	dry
10/15/2007	TOX	---	0.086	<0.010	<0.010	0.028	0.023	dry
	Mean			0.0263	0.027833	0.032083	0.108333	0.030871
	Standard Deviation (STD)			0.029705	0.032389	0.024459	0.253492	0.034754
	Mean + 2STD			0.085711	0.092612	0.081001	0.615318	0.100379



GROUNDWATER SYSTEM
MUSCATINE C & D LANDFILL
70-SDP-4-78C
CONCENTRATION VERSUS TIME

	PARAMETER	MCL mg/L	Mean + 2STD	U.W.T. MW 6	D.W.T. MW 2	D.W.T. MW 3	D.W.T. MW 4	D.W.T. MW 7
10/15/95	Phenols	---	0.024	0.005	0.005	0.005	0.005	0.005
10/15/96	Phenols	---	0.024	0.01	0.01	0.01	0.01	0.01
10/15/97	Phenols	---	0.024	0.016	0.018	0.018	0.016	dry
10/15/98	Phenols	---	0.024	0.025	0.025	0.025	0.025	0.025
10/15/99	Phenols	---	0.024	0.0025	0.0025	0.0025	0.0025	0.0025
10/15/2000	Phenols	---	0.024	0.0025	0.0318	0.0025	0.0025	0.0025
10/15/2001	Phenols	---	0.024	0.01	0.01	0.01	0.01	0.01
10/15/2002	Phenols	---	0.024	0.0025	0.0025	0.0025	0.0025	dry
09/04/2003	Phenols	---	0.024	<0.1	<0.1	<0.1	<0.1	dry
09/08/2004	Phenols	---	0.024	<0.100	<0.100	<0.100	<0.100	dry
09/08/2005	Phenols	---	0.024	<0.100	<0.100	<0.100	<0.100	dry
09/27/2006	Phenols	---	0.024	<0.100	<0.100	<0.100	dry	dry
10/15/2007	Phenols	---	0.024	<0.100	<0.100	<0.100	<0.100	dry
	Mean			0.009188	0.0131	0.009438	0.009188	0.009167
	Standard Deviation (STD)			0.007496	0.010154	0.007748	0.007496	0.007728
	Mean + 2STD			0.024179	0.033408	0.024933	0.024179	0.024623



ATTACHMENT E

Water Elevation Data

Water Level Data
Muscatine C&D Landfill

Well/TOC	MW-1	640.42	MW-2	640.86	MW-3	640.36	MW-4	693.22	MW-5	716.8	MW-6	716.63	MW-7	716.65	PZ-8	692.99
Depth of Well		67.09		42.6		22.06		24.43		76.5		48.98		22.25		46
Date	Water Depth	Water Elevation	Water Depth	Water Elevation	Water Depth	Water Elevation	Water Depth	Water Elevation	Water Depth	Water Elevation	Water Depth	Water Elevation	Water Depth	Water Elevation	Water Depth	Water Elevation
11/04/93	NT	NT	6.24	634.62	7.08	633.28	16.44	676.78	70.75	646.05	39.38	677.25	16.35	700.3	42.05	650.94
11/23/93	5.60	634.82	6.05	634.81	7.24	633.12	16.94	676.28	57.04	659.76	48.94	667.69	16.72	699.93	42.30	650.69
12/09/93	5.64	634.78	6.10	634.76	7.53	632.83	17.20	676.02	53.54	663.26	40.76	675.87	17.15	699.5	NT	NT
12/16/93	6.22	634.2	7.71	633.15	7.62	632.74	17.49	675.73	52.57	664.23	41.05	675.58	17.70	698.95	NT	NT
01/20/94	5.97	634.45	6.40	634.46	8.46	631.9	18.05	675.17	50.95	665.85	52.57	664.06	18.50	698.15	42.26	650.73
10/28/99	6.80	633.62	7.20	633.66	10.10	630.26	18.60	674.62	45.95	670.85	41.95	674.68	19.70	696.95	NT	NT
09/30/2002	7.10	633.32	7.58	633.28	10.68	629.68	18.83	674.39	44.03	672.77	41.95	674.68	20.63	696.02	34.69	658.3
03/18/2003	6.70	633.72	7.15	633.71	9.20	631.16	19.08	674.14	44.80	672	42.55	674.08	21.15	695.5	34.40	658.59
09/04/2003	7.85	632.57	8.40	632.46	11.80	628.56	20.10	673.12	45.45	671.35	43.35	673.28	21.95	694.7	36.00	656.99
03/03/2004	7.40	633.02	7.90	632.96	10.35	630.01	20.45	672.77	45.80	671	43.85	672.78	21.90	694.75	35.80	657.19
09/04/2004	7.60	632.82	8.20	632.66	11.00	629.36	20.60	672.62	45.95	670.85	43.70	672.93	21.85	694.8	dry	dry
03/10/2005	7.20	633.22	7.70	633.16	10.15	630.21	20.35	672.87	45.80	671	43.45	673.18	21.60	695.05	dry	dry
09/08/2005	8.45	631.97	9.01	631.85	12.10	628.26	20.91	672.31	46.32	670.48	43.90	672.73	21.85	694.8	dry	dry
03/15/2006	7.65	632.77	8.17	632.69	9.52	630.84	20.98	672.24	46.26	670.54	44.18	672.45	21.86	694.79	dry	dry
09/27/2006	8.64	631.78	9.18	631.68	12.28	628.08	21.54	671.68	46.57	670.23	44.35	672.28	21.88	694.77	dry	dry
03/06/2007	7.60	632.82	8.00	632.86	8.10	632.26	21.60	671.62	47.10	669.7	44.70	671.93	21.98	694.67	34.70	658.29
10/15/2007	8.05	632.37	7.60	633.26	11.30	629.06	21.55	671.67	46.55	670.25	44.42	672.21	21.85	694.8	35.00	657.99
	-		-		-		-		-		-		-		-	
Average	7.15		7.56		9.68		19.45		49.14		43.83		20.27		37.47	
Std. Dev.	0.91		0.92		1.70		1.70		6.41		2.97		2.05		3.39	
	12.69%		12.15%		17.57%		8.72%		13.05%		6.78%		10.11%		9.03%	
Maximum	8.64		9.18		12.28		21.60		70.75		52.57		21.98		42.30	
Minimum	0.00		6.05		7.08		16.44		44.03		39.38		16.35		0.00	